RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

VOL. XX JUNE, 1933 No. 6

# THE SCOPE OF ACTIVITY OF THE ROENTGENOLOGIC PHYSICIAN[1]

## ILLUSTRATED BY TEN ULCER PROBLEMS

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THIS title simply indicates a new phase of the old problem of "the status of roentgenology in the field of medicine" and, particularly, the standing of the roentgenologist compared with his colleagues in other specialties. The status of roentgenology has been under discussion for the last three decades. An early phase of this is well illustrated by a personal incident. Before I accepted my first appointment as roentgenologist to the Roosevelt Hospital, my interne associates labored zealously with me to prevent me from forsaking the desired career as a surgeon to become a so-called "medical photographer," because, at that time, the principal specialist in this line in New York was not a physician, and the x-ray plates were made throughout the city almost exclusively by the hospital engineer, apothecary, photographer, elevator boy, or bell hop. Only occasionally did a doctor associate himself with the department of roentgenology in a hospital, and then he condescended to do so only as a stepping stone to some more dignified position on the staff. George Johnson, who was often referred to as the "court jester" of the old Society, summarized the situation by saying that "the specialty of roentgenology had been born with a breech presentation." To me, it would seem rather that the older specialist rather looked upon the newcomer as an illegitimate sister.

The highly complicated technic of radiography required some knowledge of electricity for the operation and construction of apparatus and some knowledge of the principles of photography for the development of the plates. These factors soon caused roentgenology to become a specialty and, in those early days, the ability to make satisfactory roentgenograms was the chief function of the roentgenologist. Soon after he was able to obtain satisfactory roentgenograms, it became evident that the findings observed in them did not correspond with our preconceived ideas of what they should show. My personal interest in the subject of roentgenology was elicited to prove that a fracture of the middle third of the tibia and fibula, which, as an embryo surgeon, I had treated, was not in as bad position as the roentgenogram showed it to be. For more than a year before I ever made an x-ray examination myself, I worked in the department of anatomy under Hunnington, on shadows of fractured, articulated bones, to prove that the malposition observed in this first roentgenogram that had been made for me was due to "skiagraphic errors,"

[1]Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

which, subsequently, became the title of one of my first papers. The function of the roentgenologist then began to include the reading of these x-ray findings as observed in the plates, first, only as a description of what he saw and, later, interpretations of these gradations of shadows in terms of pathology. The gradual development of roentgenology occurred in the following order: (1) foreign bodies; (2) fractures; (3) kidney stones; (4) pulmonary tuberculosis; (5) infected accessory sinuses; (6) cancer of the stomach or colon; (7) ulcer of the stomach; (8) post-pyloric ulcers; (9) gallstones and gall-bladder dye procedure followed each other in rapid succession.

Advance in technic and interpretation, with rare exceptions, was largely the result of the activity of the roentgenologist, rather than other specialists. In the early days of roentgenology it was difficult for the attending physician to convince the patient of the necessity of having an x-ray examination. Later the confidence of the laity in the x-ray diagnosis led them to demand such an examination, even when it was not suggested by the physician. Often the results proved embarrassing to the physician, revealing kidney stones, pulmonary tuberculosis, cancer, or ulcer in patients he had not even suspected of having these diseases. Therefore, in those early days, the specialty of roentgenology developed rapidly. The engineer, the medical photographer, the apothecary joined in the procession and either developed commercial laboratories or occupied positions of responsibility as roentgenographers in reputable institutions, often splitting fees with the men who sent them work or with the hospital which practised medicine and used the income from this source to make up the deficits in less lucrative laboratories.

The commercial x-ray laboratories primarily organized by these non-medical men not only split fees or gave rebates to physicians sending patients to them, but they openly advertised this fact by a monthly supply of blotters. It was astonishing to note what reputable physicians would use such a blotter to blot the indorsement on a monthly check sent them by these laboratories without any request on their part. This fee-splitting with the commercial laboratories is an act which often causes the first offense of a reputable physician in the vicious habit which later extends to sister-specialties. I rejoice that fee-splitting among reputable roentgenologists is not as common as in some other specialties. The rapidly increasing demand on the part of patients to have roentgenological examinations, and the frequency with which unsuspected lesions were diagnosed by this method, caused consternation in the camp of other specialists because of the loss of prestige, and because of the apparent lucrativeness of this procedure. Therefore, members of other specialties became the ready prey for the x-ray apparatus salesman who supplied small apparatus such as could be installed in any doctor's office. In fact, these firms were not particular whether the customer was a doctor or not. This indiscriminate distribution of x-ray apparatus to those who had no experience in this highly technical specialty was like giving a pair of high forceps to a midwife. Patients who applied for medical advice were deceived by these physicians and were made to believe that they had had an adequate x-ray examination, whereas the doctor who merely looked at them through the fluoroscope had had no previous training in roentgenology. Such practices temporarily encroached on the field of the competent roentgenologist, but permanently reflected discredit upon the ability of the doctor who adopted them. The patient who learns by subsequent examination that such a doctor knows nothing about x-rays, suspects that this doctor knows no more about clinical medicine than he does about roentgenology.

However, such dumping of small x-ray

apparatus on the general medical practitioner by large and reputable manufacturers has led to consternation among roentgenologists as to the present status and future possibilities of roentgenology as a specialty. The demand for competent roentgenologists has far exceeded the supply, due, in part, to the rapid development of the specialty because of its value in solving many problems of diagnosis and treatment. This is a condition which could not be wondered at, but the principal reason for the lack of supply of competent roentgenologists is the fact that the medical colleges and universities were not only slow in forming courses for adequate undergraduate instruction, but were also slow in giving post-graduate instruction. The excuse of the medical faculty of such institutions for not giving adequate undergraduate instruction is the insufficient time for the study of essential subjects and they consider roentgenology an unimportant one, even though it plays some part in the diagnosis, differential diagnosis, or treatment in more than half of the cases presented to them. In many of the institutions in which some instruction is given in roentgenology a concerted effort is made to distribute the roentgenologic work among the various departments so that its immense value in diagnosis shall not embarrass the older sister-specialties. In this way, the x-ray diagnosis is kept under control so that it does not compete with the older clinical methods in the diagnosis of lesions and, particularly, in the other problems of medicine.

This competition between clinical and roentgenologic methods was well illustrated in the problem or controversy concerning the relative value of the clinical diagnosis of tuberculosis compared with the roentgenologic diagnosis. It was not until Lawrason Brown was converted and became a Saul of Tarsus that his preaching of the gospel of roentgenology converted so many of his clinical colleagues. Roentgenology has now become the foundation upon which not only the diagnosis but the classification—the extent and activity of the process—is builded.

The consternation among roentgenologists as to the status of roentgenology has been indicated by casual remarks in and out of medical meetings since the very birth of this specialty, but its aggravation at the present time is denoted by the fact that it was the theme of two of the invited papers at the Third International Congress (Paris, 1931), where it was discussed by Dr. Lynham and by the speaker. Furthermore, it was the theme of the Caldwell Lecture at the 1931 meeting of the American Roentgen Ray Society. Haenisch came all the way from Hamburg to emphasize the significance of the unstable status of roentgenology abroad, especially in his own country, and to warn us of the same approaching danger in this country, but he offered no suggestion as to a means of escape from this danger. On the other hand, Dr. Lynham, of London, suggested a roentgenologic institute, similar to that in London, composed of physicians, physicists, technicians, and even manufacturers, to work in harmony in attempting to prevent the evil practices which threatened roentgenology as a specialty. I am not so much concerned as to whether or not roentgenology continues as a pure specialty as I am concerned with the grade of roentgenology practised—by the physician, as a clinician, by the roentgenologist, as a specialist, or by specialists in other lines, using it in their own work, provided only that they have prepared themselves by technical training and by ample instruction in interpretation of the roentgenological findings. I am, however, vigorously opposed to the installation of an x-ray machine in a doctor's office for advertising purposes, wherewith he makes only an inadequate, or even fake, x-ray examination to satisfy the demand of the patient, and, perhaps, to get an additional fee to help him pay for the apparatus.

Many of the younger men who entered

the field of roentgenology as a specialty are unable to obtain an adequate training, and this, together with the fact that they are young, prevents them from enjoying the respect which has finally been bestowed upon some of the older roentgenologists. During the latter part of this period of the development of roentgenology as a specialty, two schools have become manifest. One school limits its scope to the making of roentgenograms or fluoroscopic examinations, describing the findings so observed and, in some cases, interpreting these findings into a diagnosis. In many cases, however, these roentgenologists simply report the findings as "filling defects of the stomach" or "an area of density in the lungs" or "cloudiness in the antrum," etc., leaving the interpretation of these findings to the clinician to whom the report is sent. Such roentgenologists shift the responsibility of the roentgenologic diagnosis to the clinicians, rather than assume it themselves. The other school of roentgenologists applies the roentgenologic findings as observed, either fluoroscopically or roentgenographically, to the solution of many problems of medicine and surgery. Exceptions which the first school makes to the rule of simply reporting roentgenologic findings (and, possibly, giving a diagnosis) are evidenced in the following procedures. For example, a shadow denser than the bone is evidence of a metallic foreign body and, if this is the size and shape of a bullet, it results in the diagnosis of a bullet. Diagnosis ends here but localization, especially by fluoroscopic control during an operation, becomes more than a diagnostic problem—it becomes an important factor in surgical treatment; perhaps even more important than the cutting by the surgeon himself. Again, the position of the fragments in a fracture becomes the most important phase in the surgical treatment and either the roentgenologist or the surgeon must make the decision as to whether these fragments are in a satisfactory position or not. This decision must, in turn, be based upon the roentgenologic findings. Whether this is done by the surgeon or the roentgenologist is not so important, but roentgenology becomes the prime factor in the solution of this problem. Let us cite another example. A kidney stone is readily diagnosed, for instance, but whether it is of size or roughness so that it will not pass becomes a roentgenologic problem. Roentgenologic findings in pulmonary tuberculosis are so characteristic that they have not only become the basis of diagnosis, but, thanks to Lawrason Brown, they also have become the basis for classification as adopted by the American Tuberculosis Association. This takes the field of roentgenology beyond diagnosis and makes it an important factor in prognosis and indication for treatment. Well organized cicatricial, or even calcified, tubercles constitute the diagnosis of pulmonary tuberculosis, but these lesions should be definitely differentiated from the soft, mushy, snow-flake-like appearance characteristic of the subacute, exudative lesion. Almost complete resolution of such an acute exudative process as this was not even suspected until revealed by a series of roentgenograms made at short or long periods of time. Therefore, diagnosis, prognosis, life history of the disease, indication for treatment, and the results of treatment may be determined by this method of examination. Whether these findings are to be interpreted by the roentgenologist or the clinician is not important as long as either is qualified by experience to interpret the findings. Thus, many of those who are advocates of the simple, safe, and sane school have been forced beyond their ramparts by this inevitable trend of progress.

This trend of progress did not come of itself. The older men will remember the bitter opposition to the roentgenologic diagnosis of pulmonary tuberculosis, even by our

own specialists. This antagonism began at the 1907 meeting of the American Roentgen Ray Society, at Cincinnati, and raged for several years. Even within the memory of the younger men, it has met with opposition from clinicians. The bitter controversy among ourselves concerning the value of roentgenologic findings in the diagnosis of duodenal ulcer centered at the Boston meeting of the Roentgen Ray Society, in 1913. It did not come without bloodshed, not as literal as the Battle of Bunker Hill, but with the same spirit. Now we may ask ourselves if these days of roentgenologic advance as applied to the problems of medicine have ceased. Must we now be content to relate these as historical events, or are we still within the era of history-making as roentgenology is applied to the problems of medicine? Those who adhere to the simple, sane method of reporting only findings and, possibly, diagnosis, may be called the conservative school. Those who hold the other point of view may call themselves the progressive school. The conservatives will call them radicals and within their ranks will be found all shades of radicalism, from the pale pink (just off the snowy white) of conservatism to the fiery red of radicalism. However, even the extremes to which we today point will not compare in radicalism to many statements of the past: For example, in 1904, that one can make a diagnosis of renal calculus with sufficient accuracy so that it may influence the diagnosis or treatment of the lesion; in 1907, that the x-ray will in time prove to be the important factor in the diagnosis of tuberculosis; in 1908, that the diagnosis of cancer of the stomach can be made with a greater degree of accuracy by this method than by all other methods combined, or, in 1913, that by the x-ray one can diagnose the new disease, duodenal ulcer. (Up to five years before that time it was practically unknown and had escaped the detection of world-renowned pathologists.) Compared with these statements—so radical in *their* day—the statements of to-day will be lily-white or tinged only with the slight color of progress. This finding brings us to the subject of this communication, namely, the scope of the activity of the roentgenologic physician.

Any one of innumerable lesions might be used to illustrate this subject, but one is selected in which I am especially interested, namely, gastric ulcer. This is, also, selected because it has been the center of great controversy which continues to involve all phases of the ulcer problems. What are these ulcer problems? There are ten of them.

1. Diagnosis—Has the patient got an ulcer?
2. Treatment—Should it be treated medically or surgically?
3. Malignancy—Do benign ulcers frequently become malignant?
4. Etiology—
   *(a)* Why does the ulcer develop where it does?
   *(b)* Why does the ulcer develop when it does?
5. Pathogenesis—How does the ulcer develop?
6. What is the life history of an ulcer?
   *(a)* Treated medically.
   *(b)* Untreated.
7. Process of repair—How does the ulcer heal?
   *(a)* By granulation tissue.
   *(b)* By cicatricial contraction.
8. If treated surgically, what operation is indicated?
   *(a)* Gastro-enterostomy.
   *(b)* V-excision.
   *(c)* Sleeve resection.
   *(d)* Partial or subtotal gastrectomy.
9. What is the result of medical treatment?
   *(a)* Mortality.
   *(b)* Morbidity.
10. What is the result of surgical treatment?
   *(a)* Mortality.
   *(b)* Morbidity.

To be convinced that these problems present themselves in each ulcer case, one needs

only to sit in the consultation room and check this list. Rarely would any of these problems, except etiology and pathogenesis, escape discussion. Now let us apply roentgenology to a solution of them.

1. *Diagnosis.*—The negative or positive diagnosis of gastric ulcer rests almost exclusively upon the roentgenologic findings. Few are the surgeons who would operate on a chronic gastric ulcer without its presence having been established by roentgenologic findings.

1-*A. Differential Diagnosis.*—The differential diagnosis of cancer from ulcer is even a more difficult clinical problem than diagnosis. How can the x-ray help? If we combine all of our clinical and roentgenologic evidence of cancer and ulcer into a single group of evidence and say that it indicates an organic lesion (as is done in some of the larger clinics), the next question is, With what ease and degree of assurance can we separate these malignant and non-malignant lesions from each other solely by an observation of the roentgenologic findings? For example, if we were to take 56 cases of such organic lesions of the stomach, cancer and ulcer combined, and shuffle the charts, and single characteristic films from each serial set of roentgenograms, as one would shuffle a pack of cards, any one of you, or all of you, can pick the cancers from the ulcers by the roentgenograms as readily and as rapidly as one can separate the reds from the blacks in a pack of cards. In each new pack of cards there is a joker, an advertising card, and two blanks which may subsequently be used either as reds or blacks. So with the 56 cases, the proportion of jokers and blanks is almost exactly the same. Over and over again, I have watched medical students pick the malignant from the non-malignant lesion by this procedure and I know whereof I speak. You may ask, "How about the 8 per cent of jokers and blank cards?" A subsequent roentgenographic examination after the patient has rested in bed two weeks will decide whether the two blanks are to be red or black—ulcer or cancer. The joker will remain a joker until the bitter end, defying the clinician, the surgeon, the roentgenologist and, particularly, the pathologist, even when he has the gross and microscopic specimens in hand. Only by death or continued life is the status of the joker settled. This is no jest or joke —I have absolute proof of this group of cases which will be the subject of our next communication.

2. *Treatment.*—Should it be medical or surgical? Clinicians and surgeons will argue this point on *generalities* until "kingdom come," but in *specific cases,* observed roentgenographically, this problem is easy. What medical man would wish to treat such a case as this medically?[2] Or what present-day surgeon would wish to operate on an ulcer as small as this?[2] Although, as a matter of fact, in the dark days of ignorance, this particular ulcer was treated surgically. Between these extremes there are a great many medium sized ulcers, such as this.[2] The question arises, Which of these medium sized ulcers should be treated medically, and which surgically? This problem will be answered later in this paper under the heading, "The Results of Medical and Surgical Treatment as Observed Roentgenographically."

3. *Malignancy of Gastric Ulcer.*—Do benign gastric ulcers frequently become malignant? Clinical histories *can* be interpreted in such a way as to indicate that ulcers do become malignant, but the roentgenologic evidence indicates that benign gastric ulcers do not become malignant. That some ulcerating lesions may have malignant invasion in one or more areas of the surrounding mucosa, there can be no doubt, but we believe these were malignant from the

[2]Slides were shown demonstrating different types of gastric ulcer.

start. The frequency of this particular type of lesion compared with the benign type of gastric ulcer, on one hand, and the ordinary types of carcinoma, on the other, is relatively slight. Such malignant ulcers do not diminish in size in two weeks on rest in bed, and benign gastric ulcers, regardless of their size, *will reduce* very materially, usually to one-half their original size, in two weeks if the patient is kept in bed. Thus one can readily establish the differential diagnosis between these ulcers with a malignant lip and the benign gastric ulcer, by the very simple procedure of keeping the patient in bed for a period of two weeks, and making a second roentgen examination at the end of this time.

4. *Etiology:*

*(a)* Why does the ulcer develop where it does? The fact that ulcers develop on the ventral and dorsal surface of the stomach close to the lesser curvature is proven by roentgenograms of, approximately, 350 cases. A line drawing of the stomach, with a dot indicating the location of these ulcers, graphically attracts one's attention to their peculiar distribution. Here, for the first time, the roentgenologist may be required to go out of his field of activity for an answer to the problem. The question now presents itself, Shall he, by personal investigation of either literature or specimens, look to see what anatomical structures correspond with this peculiar distribution of the gastric ulcers? As a medical photographer, he does not claim this right, but as a physician, his field is not necessarily limited to the making and interpretation of roentgenograms. As precedent for extending his activity from one field of research to another in search for the truth concerning these problems, my worthy predecessor offers the most glorious example. From the roentgenographic examination of a bone lesion of the upper end of the humerus I was unable to make a positive diagnosis between infection and malignancy, although I leaned toward the infectious side. Surgery was performed by Dr. R. P. Wadhams and both the microscopic sections and roentgenograms were submitted to Dr. Ewing.

From Ewing's study of the microscopic slides, as a pathologist, he considered the lesion malignant. From his observation of the x-ray findings, he considered it non-malignant. Which of these did he choose to make his final diagnosis of malignancy or non-malignancy? He chose the x-ray findings—and the x-ray findings as *he* interpreted them. I would rather have *his opinion* of the x-ray findings as to the malignancy of this lesion than the opinion of nine-tenths of the roentgenologists. In fact, I think I would rather have his opinion, based on the roentgenologic findings, than the opinion of any roentgenologist of whom I know. If, by *his* intensive study of *roentgenograms* of bone lesions, he has strayed from the field of pathology and broken down the fence which separates his pastures from ours, *why may not* some of us stray into the pastures of pathology, and do so without either him or his colleagues feeling that we are trespassing? Personally, I have found the grazing in these adjacent pastures of pathology and anatomy most gratifying. If anatomists or pathologists have *not* noted the coincidence of the anatomical relation of the terminal branches of the left gastric artery to that of the most frequent location of corporic ulcers, or if this finding has been observed but buried in the archives of pathology, a reiteration of this finding by a roentgenologist may not be amiss.

*(b)* Why does the ulcer develop when it does? This is the only phase of the ulcer problem in which I am uncertain of the facts. When these facts are presented, as they will be in the study of pathogenesis and the process of repair, others instinctively jump to a certain conclusion, which I too

have formed. I am unwilling, however, to present this conclusion, lest it weaken the other portions of the article, for which ample proof is submitted.

5. *Pathogenesis.*—How does the gastric ulcer develop? Can the x-ray help us here? That gastric ulcers *develop* as *small* mucosal ulcers and *gradually* increase in size, by the acid gastric secretion gradually eating or digesting away that portion of the gastric wall that is unprotected by the mucosa in a manner specifically described by Aschoff, is so firmly established in the minds of clinicians and surgeons that few are cognizant of any other conception of the development of gastric ulcer. Yet, roentgenographically, the evidence is overwhelmingly in favor of some other manner of development of benign gastric ulcer. In proof of this, we submit the fact that many mucosal ulcers have been recognized roentgenographically and have been followed by subsequent examinations, and never have we observed a small mucosal ulcer that has subsequently become a large "true ulcer." Furthermore, we have never seen a truly benign gastric ulcer which, at a subsequent examination, was seen to be larger than it was at first. If ulcers do not develop in the orthodox way, is there any roentgenologic evidence to indicate how they do develop? A few cases have been observed roentgenographically during the early stage of pathogenesis and these have been seen to yield peculiar roentgenological findings. The crater, instead of being clear-cut and well-defined, as it usually appears, is deep and irregular as if the barium were mixed with some strands of non-opaque substance. Roentgenograms made of this case at a later date showed the conventional clear-cut crater usually observed in gastric ulcers. The ragged, irregular crater shown in the first roentgenogram was similar to the crater of a boil before the core had been extruded, and in the later stage after the core is out the crater has the conventional appearance. This finding has been observed in several cases and leads to the conception of the gastric ulcer beginning as a boil. That is, the lesion begins as a necrotic area somewhere within the gastric wall and the exact location of the initial necrotic area predetermines the type of ulcer which will subsequently develop. Again may we stray into the green pastures of the pathologists through the rent in the fence already made by them and used by us, and search for the facts to confirm this conception of the pathogenesis of gastric ulcer? As an amateur pathologist without a knowledge of others' findings, and without the guidance of a professional pathologist, I have observed gross and microscopic findings confirming the roentgenologic findings as to the boil conception of the pathogenesis of gastric ulcer.

6. *Life History of Gastric Ulcer.*—How long does the gastric ulcer last and does it change in size or shape during its life history? Clinical symptoms suggestive of a gastric ulcer over a prolonged period of months, or even years, is considered one of the principal points of differentiation between ulcer and cancer by those who believe that ulcers do exist for a long period of time and cancers are usually of short duration. The gross and microscopic pathologic findings would seem, on superficial observation, to confirm this theory of long duration, but we believe that we have pathologic evidence to disprove this. These findings and conclusions will be described later under the heading "Process of Repair." Again we will revert to the roentgenologic findings to see if they help in determining the length of time that an ulcer lasts and if, under roentgenologic observation, it is observed to heal. Also, What is the process of repair by which the crater diminishes in size? Single roentgenologic examinations of gastric ulcers made during the life history of an ulcer reveal that the craters of gastric ulcers vary in size and shape. Early in our study of this subject, we classified ulcers accord-

ing to the size and shape of the crater and these were named because of the similarity of the crater to some object that they resembled. Thus, we had the large, indurated, or "palm-like" ulcer, the "letter-box ulcer" of Moynihan, because it had a constricted neck, or if it was small it was called the "collar-button ulcer"; others were designated as the "delaminating ulcer," or the small, round, or "punched-out" ulcers. These ulcers of various size and shape were originally considered as totally different types of ulcers, but, by repeated roentgenologic examinations, three or four days apart, we found that they were not different types or kinds of ulcers but simply different stages in the life history of the same ulcer. That is, a large, indurated, or "palm-like," ulcer soon contracts at the neck and becomes a "letter-box ulcer" and as it diminishes in size it becomes the "collar-button ulcer." It finally diminishes to a small, round ulcer. Other ulcers start as small, round ulcers and never go through the previous types of repair. By repeated examinations of ulcers every three or four days, we have come to know the life history of these ulcers; that is, whether they last for months or years, or whether they disappear in a short period of time. Even ulcers that are much larger than the proverbial quarter will habitually heal in about a month. Thus, we have established that the ordinary variety of benign gastric ulcer is short-lived, not much longer in duration than a boil or carbuncle on one's neck.

So much for the life history: Now the question arises, How does it heal? This problem of repair has had very little consideration but, from the roentgenologic findings, it is evident that gastric ulcers heal in two distinctly different ways. These will now be considered under the heading "Process of Repair."

7. *Process of Repair.*—The crater of a benign ulcer is gradually diminished in depth and diameter and, secondly, by an annular constriction just beneath the mucosa which causes it to have a constricted neck, causing the "letter-box," "lagoon," or "collar-button" appearance. These findings were observed by repeated serial roentgen examinations. We will again stray into the pathological pastures in search of microscopic evidence bearing on the process of repair. If one searches a microscopic slide for something other than to determine whether or not the ulcer is malignant, he will find a most interesting field of investigation. Such an investigation reveals specifically the two processes of repair which were observed roentgenographically, namely, the filling of the crater from the bottom with newly formed fibrous tissue of various ages and, secondly, its diminution in size, particularly, just beneath the mucosa, by a cicatricial constriction of a deposit of connective tissue in the submucosa. This constrictive ring of connective tissue is like a cruller or quoit with a hole in the center around which the connective tissue readily contracts. Thus, the ulcer is diminished in size, first, by a growth of granulation tissue in the bed of the ulcer, and, secondly, by cicatricial contraction of the connective tissue surrounding it—both of these processes going on at the same time. The life history of the gastric ulcer is principally influenced by rest in bed, which relieves the torsion on the terminal branches of the left gastric artery. The fact that the average time required for an ulcer cure, or complete healing of the crater, is less than a month has been such a surprise to many clinicians that they have suspected that perhaps the roentgen examination had something to do with it. It is true that these patients had from twelve to eighteen roentgenograms made every three or four days and that the barium might have exaggerated the effect of the radiation by causing secondary radiation, but we have no proof or disproof of this contention. My own opinion is that roentgen rays may tend to prevent superficial

mucosal ulcers by diminishing or destroying the increased lymph follicles which are observed in the mucosa in all of these cases of small mucosal ulcers, and, in addition to this, they may have something to do with the process of repair. We know that boils on the neck are aborted or hastened in repair by x-ray treatment and, in my opinion, an ulcer of the stomach is nothing but a boil of the stomach. We believe that rest in bed causes a diminished tug on the terminal branches of the left gastric artery, thus increasing the blood supply so that it is greater when the patient is in bed than when he is in the erect posture. In one case in which a patient was undergoing bed treatment for gastric ulcer, he signed himself out at the end of two weeks at a time when the ulcer had become diminished to about one-half its original size. He remained up and about during the next month without rest in bed and the ulcer did not diminish in size during this time. He then returned to the hospital and, on bed treatment, it completed its cure in another two weeks. We believe that the rest in bed is a factor of paramount importance in the treatment of gastric ulcers, particularly those that occur near the incisura angularis.

8. *If treated surgically, what operation is indicated?* Four operations are available: *(a)* gastro-enterostomy; *(b)* V-excision; *(c)* sleeve resection; *(d)* partial or subtotal gastrectomy. Can the roentgenological evidence aid us in determining which of these particular operations is the best suited for the particular case under consideration? Individual surgeons habitually come to use one or the other of these procedures for most of the cases which present themselves for operation, regardless of the location or characteristics of the ulcer. Nevertheless, if practically all benign gastric ulcers will heal on medical treatment (rest in bed), why consider the type of surgical treatment which is necessary, except in the few cases in which there is extreme gastric deformity or pyloric stenosis caused by a slipping or wadding of the mucosa so that it obstructs the pyloric canal and demands surgical relief? In such cases the roentgenologic findings are of great value in determining the type of operation that is best suited for the particular case under consideration.

9. *What is the result of medical treatment of gastric ulcer? Can the x-ray help in determining this?*

*(a) Mortality of Gastric Ulcer.*—Of all the patients with benign gastric ulcer treated medically, I am unaware of a single one who has died while under treatment. One patient, having an unusual pathologic type of ulcer with a most unusual clinical history, suffered from repeated hemorrhage and might have died under medical treatment had an operation not been performed. He did die after a simple jejunostomy. Actually, in our experience, there has been a zero mortality for medical treatment.

*(b) Morbidity(?)*—Morbidity is divided into two problems: Does the ulcer heal and remain healed or does it recur or do other ulcers form? Almost without exception, benign gastric ulcers, regardless of their size, heal in about three or four weeks if the patient is put to bed. In a limited number of cases symptoms recur, but in most of these cases if a subsequent ulcer is observed, it is located in some other region of the stomach; that is, if the first one is in the corpus, the second one will be in the pylorus, or *vice versa*, or one will be on the ventral and the other on the dorsal surface or, in some cases, they may be separated by only a centimeter or so. Very rarely another will occur so close to the original site that it may be considered a recurrence of the same ulcer. Again, the gastric ulcer is like a crop of boils on one's neck. A second or third boil is not considered a recurrence of the same boil, but a new boil; so with the ulcers. Some patients are susceptible to

ulcers and develop new ones which have a normal life history of three, four, or five weeks.

10. *Results of Surgical Treatment.*

*(a) Mortality.*—The mortality for gastric resections for corporic ulcers in my own personal experience, with good surgeons, runs about 50 per cent. With V-resections or sleeve resections it is only slightly less, and for gastro-enterostomy without excision or cautery and purse-string closure the mortality is considerably less, but the ulcer is not removed.

*(b) Morbidity.*—Morbidity with all its complicating factors, incomplete relief of symptoms, marginal ulcers and the inefficient follow-up histories, especially when these are made by the surgeon who performed the operation, are such that I do not wish to discuss the morbidity of gastric ulcers treated surgically, but if practically all benign gastric ulcers heal under medical treatment, why should we discuss the mortality or morbidity of surgical treatment? It is only in those few cases which are habitual ulcer-bearers that surgery might be considered, but, even in the case of these patients who do develop crops of gastric ulcers, I would most emphatically warn you to beware of subsequent jejunal ulcers after a gastro-enterostomy or even after a pylorectomy. We believe that roentgenology is the final acid test to be applied to all gastric ulcer cases to determine the results of either medical or surgical treatment and the relative value of each.

Now as to the scope of the activity of the roentgenologic physician—if he chooses to limit his activity to the making of roentgenologic examinations, either fluoroscopic or roentgenographic, and of simply reporting his findings as filling defects, irregularities, etc., making a definite diagnosis of cancer or ulcer in, say, half of the cases, and merely giving his impression in the other half, he selects the simple, safe, sane, and easy way to practise roentgenology. But if he follows such a procedure, he becomes only a "good medical photographer," with no more responsibility than a medical photographer or technician often assumes, and, if so, he must suffer the consequences. On the other hand, if one learns to apply roentgenologic findings to all the problems of medicine, as we have shown they can be applied to the complicated, complex problems of gastric ulcer, then he may become of such value to the institution or community he serves that he no longer need worry concerning the much discussed subject of the status of the roentgenologist, at least, so far as he personally is concerned. A very serious problem, however, is the manner in which he seeks to apply these roentgenologic findings in his institution or community. This may be done diplomatically or antagonistically. Regardless of how I do it personally, I believe that it should be done diplomatically. When a doctor comes to see a series of roentgenograms of an ulcer case he has sent you, show him a similar case that has healed under medical treatment. If he doubts the single case, show him another. This, apparently, may not have any effect upon him, but as he thinks over it during the next week, he will wonder if he had better not try medical treatment, and, if he carries it out correctly, it will succeed. He then will think that he has discovered that gastric ulcers will get well under medical treatment, and he may write an article on it, completely forgetting where he got the idea—but never mind that. A few ulcers will not get well in two or three weeks. Most of these are malignant or are caused by some unusual pathologic ulcerative lesion, worthy of reporting with roentgenologic and pathologic findings. The infrequency with which an ulcer which has the roentgenologic findings of a benign gastric ulcer subsequently becomes malignant, is so far below the mortality which would result from an operation of sufficient severity to even hope for a cure

were the ulcer malignant, that this factor should not be considered; at least, it should not be used as a crowbar to pry the patient onto the surgical table.

The problems of etiology, pathogenesis, pathology, life history of the ulcer, and the process of repair are problems which will interest only those who have a scientific bent. The roentgenologist can influence the surgeon to use some operation particularly applicable to the individual case being studied by simply showing him the result of such a procedure on some previous similar case. The surgeon, too, may forget the source of his inspiration to try some new operation or, at least, some operation which was new to him, and he may soon use it as the subject of an article.

Surgical specimens are getting more and more scarce. I used to be able to get any number of specimens of gastric ulcers from various hospitals but, because of the fact that almost invariably sections of these specimens show that the ulcer was in the active stage of repair at the time it was removed, many of the surgeons who originally cooperated with me in collecting this material have ceased to operate on ulcers. Thus, in many instances, we have killed the goose that laid the golden egg of freshly removed surgical specimens and now the source of surgical specimens of gastric ulcer is largely limited to one or two hospitals well known in our community.

In order to judge all these factors for oneself, one must be more than a medical photographer. You must follow the case to the operating table or to the morgue; you must study the gross and microscopic specimens to see how they compare with the previous roentgenologic findings; you must follow the clinical and, particularly, the roentgenologic results of both medical and surgical cases and, very often, you must do this without compensation. However, by so doing, you will come to know for yourselves the facts just presented and, by diplomatically presenting these facts to your medical and surgical associates, you will gradually become of such value to your institution and to your community and to your colleagues, that the status of the roentgenologist, particularly insofar as you are concerned, will cease to be a problem.

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## EXPERIENCE IN IRRADIATING ALL TYPES OF BONE TUMORS[1]

By MAX KAHN, M.D., Baltimore, Maryland

FOR the purpose of x-radiation of bone tumors, it has been found convenient to divide the tumors into two main groups, the benign and malignant. These again can be subdivided into the radiosensitive, partly radiosensitive, and nonradiosensitive.

The giant-cell tumor is commonly benign and frequently radiosensitive. A number of cases cured by irradiation alone have been reported in the literature. This giant-cell tumor is not the typical giant-cell tumor, but the variant type, namely a bone cyst, containing giant cells which occur in the shaft side in young persons. A reaction follows soon after a course of irradiation, manifested by swelling of the surrounding soft structures, with more or less temporary increased distention of the tumor itself. This may continue for from three to six weeks, when there is a gradual diminution of the swelling of the soft structures and the tumor undergoes considerable regression. About this time there may be beginning evidence of calcification, slight at first, but with a gradual and definite increase in a few months.

[1]Read before the Radiological Society of North America at the Seventeenth Annual Meeting, at St. Louis, Nov. 30-Dec. 4, 1931.

The expansion by then may have very largely undergone regression and the tumor tissue may be replaced with a varying degree of new, dense bone. The giant-cell tumor lends itself well to x-radiation. It is noteworthy in that it is both benign and radiosensitive and that cures may be obtained from irradiation alone, particularly in the long bones. In the small bones, such as the patella or the os calcis, failure is more common, although in some of these, cures have also been reported.

Typical bone cysts, which also come within the benign group, are not radiosensitive. These tumors, irradiation of which apparently produces very little or no change, are either best left alone or treated surgically. On the other hand, the acute bone cyst (variant type of giant-cell tumor), as noted above, is radiosensitive and yields to irradiation.

Exostosis, another benign tumor, is nonradiosensitive, since it is highly differentiated and contains a large element of osseous substance. Attempts to produce regression or absorption have proven ineffectual.

Chondromas, which are benign, are partly radiosensitive. Irradiation slows the growth when they are situated in the large bones, particularly in the sternum. One case of this kind, which has been under my observation and treatment for eight-and-a-half years, is reported in this paper (Case 2).

Of the malignant tumors, Ewing's sarcoma and chondroblastic sarcoma are radiosensitive. Because these tumors sometimes regress rapidly, the patient may remain symptom-free for from a few months to a few years. His condition during this time generally is improved until recurrence takes place, when degeneration occurs rapidly. Frequently there is metastasis to the lungs.

Secondary chondromyxosarcoma is partly radiosensitive and irradiation should be pushed, if resection or local operation is performed. Metastatic carcinoma is also partly radiosensitive and should always be irradiated. The best results are obtained in cases in which the metastases are multiple rather than single, particularly from carcinoma of the breast. Multiple metastases from hypernephroma do not yield as well. These patients may sometimes live for four or five years in relative comfort. In multiple myeloma, irradiation is of value particularly as a palliative measure, although in some cases regression, and partial recalcification, has been obtained.

In the non-radiosensitive group, sarcoma of bone, such as the extremely undifferentiated type of osteolysis and chondromyxoma, are not benefited by irradiation; they are usually fatal despite any treatment. Included in this group is also the highly differentiated sclerosing sarcoma, which is resistant to irradiation.

This study brings up the subject of the best method of treatment of bone tumors, whether it is by irradiation alone, or by surgery, or by a combination of both. It is quite obvious that surgery is the method of choice in those malignant tumors in which amputation is definitely indicated. Irradiation should be given shortly after the amputation, the former being continued for a long time. On the other hand, if the malignant tumor is large and inaccessible, or difficult of surgical removal, irradiation should be resorted to and pushed to the limit. Sometimes, in a case of this kind, regression will occur, or the growth will be arrested, and months or years added to the patient's life; or an otherwise inoperable growth will be made operable. In the bone tumors discovered early roentgenographically, the best plan of treatment is to start irradiation as soon as possible. No harm will be done in giving the treatment while one is waiting to obtain a correct diagnosis. The diagnosis may not always be exact, if no biopsy is done. It will then have to be based on the roentgenographic evidence, clinical history, physical examination, and other laboratory tests. Indeed, a number of cases have been

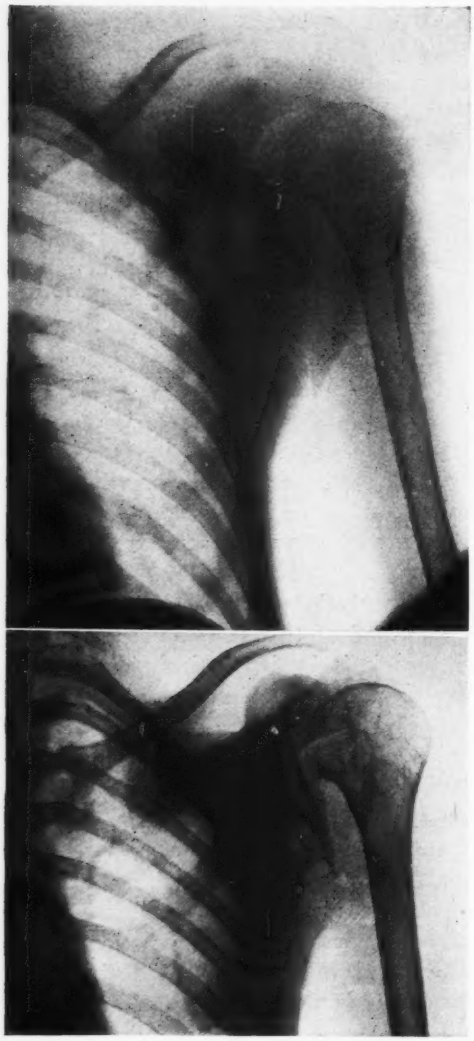

Fig. 1 *(above)*. Case 1. Extensive destruction of the scapula suggesting a malignant bone tumor, with infiltration of neighboring soft structures. Head of humerus dislocated upward.

Fig. 2 *(below)*. Case 1. Eight years after deep irradiation. Note re-formation of scapula, with areas of absorption in region of glenoid. Head remains dislocated upward but there is good function. Patient is clinically well. Practically no change has been noted in the bony structures in the last three years.

irradiated with splendid results, without resorting to biopsy. We feel that, if the patients are treated by an experienced roentgenologist, irradiation has advantages over surgery in certain types of bone tumors; but we also feel that, in inexperienced hands, radiation therapy is best not employed. It is necessary, therefore, to decide which method is the proper treatment, irradiation, or surgery, or both. The selection of the correct treatment requires, in addition to the clinical history, physical examination, and laboratory tests, a knowledge of pathology and—most important—experience in the x-ray diagnosis of bone tumors.

### CASE REPORTS

Case 1. C. McQ., age 16 years, was first seen by Dr. Bloodgood and the essayist on Jan. 25, 1923. He complained of pain in the left scapula and inability to move the shoulder joint easily. He remembered having fallen on the shoulder about five months earlier. There was a swelling which had been present since then. There was no marked pain, only tenderness. Examination showed the left shoulder lower than the right, the left wing scapula not being seen. The most marked swelling was toward the arm, below the spine. On palpation, swelling, which felt like edema, was noted, chiefly over the portion of scapula below the spine. Below the spine there was marked infiltration of the soft parts. There was suggestion of fluid in the joint.

A number of x-ray examinations were made during the first year, before and after irradiation. A review of the several roentgenograms of the chest and left scapula made from Jan. 31, 1923, to Jan. 23, 1924, reveals the following. There was marked destruction of the left scapula, chiefly in the region of the glenoid cavity and coracoid process and body. The spine of the scapula and acromion process appeared intact. The head of the left humerus and shaft revealed bone atrophy. The head was displaced upward so that it was out of the glenoid cavity. There was considerable swelling and infiltration of the soft structures surrounding the left shoulder girdle. Roentgen ex-

amination of the lungs revealed moderate fibrosis, with a little peribronchial thickening, and several calcified shadows in the right and left hilus and in the lung fields. There was no positive evidence of metastasis.

For about a year, the patient received, at intervals of two and one-half months, deep x-ray therapy directed over the left shoulder girdle through different portals of entry. Roentgenograms of the chest from time to time revealed the restoration of the body of the scapula, coracoid process, and, to a lesser degree, the glenoid cavity. The swelling and infiltration of the soft structures completely disappeared. No marked changes of the lung structures were noted in the several roentgenograms.

In September, 1925, there was a small inflammatory area on the arm a little below the axilla, which had the appearance of a red indurated area, resembling infection. When it ruptured and discharged a small amount of purulent material, a little of the exposed tissue was removed. Dr. Bloodgood's note on the microscopic study was, "We are dealing with granulation tissue, very vascular. No evidence of sarcoma. This indicates that it had nothing to do with the disease, but is probably an accidental infection."

The patient, who has been under observation for nearly nine years, is examined about once a year, and was last seen in July, 1931. At that time, the x-ray examination of the chest and scapulæ revealed a completely restored left scapula. Clinically, the patient is well, enjoys life, and is able to work.

This case is of especial interest because, clinically, the lesion was thought to be inoperable and we believed that we were dealing with sarcoma involving the scapula, with infiltration of the surrounding soft structures. No microscopic diagnosis can be offered, but the result has been excellent and the patient is well of an apparently malignant tumor.

Case 2. F. S., white, male, age 39 years, married. The patient stated that, when wrestling 11 years before the present examination, he was squeezed against the head of his opponent. He remained in bed for a few weeks at that time. About a year later he noticed a bulging about the size of a thumb in the region of the sternum. Two years after, the lump on the sternum gradually enlarged, increasing to the present size.

Fig. 3. Case 3. Destruction of the ischium, in all probability due to sarcoma arising in an osteochondroma before deep irradiation.

The patient, who was first seen in March, 1923, has been under observation since. He received the first course of deep therapy over the sternum on March 20, 1923, and has had up to the present time [1930], deep irradiation at intervals varying from two and one-half months to four years.

The first x-ray film revealed a tumor of the sternum, which we believed to be chondroma. Since then it has grown larger very slowly and there is now an increase in calcification. The lungs are essentially negative. The heart has been enlarged from

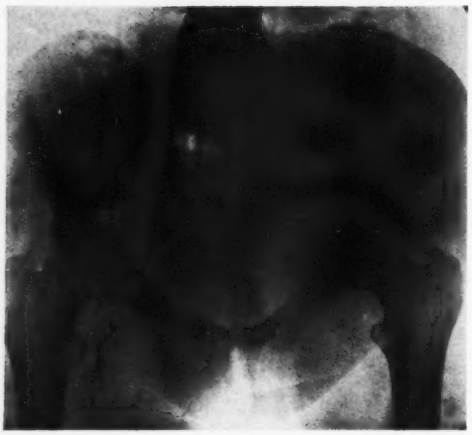

Fig. 4. Case 3. The pelvis reveals recalcification of the ischium five years after deep irradiation.

the first time the patient came under observation.

There has been no surgical intervention; the only treatment has been deep irradiation. The patient is at present clinically well and is able to attend to his work as salesman. It may be of interest to note that his son, F. S., Jr., age 17, a student, has a chondroma of the middle phalanx of the left index finger, suggesting inheritability of this tumor.

Case 3. Mrs. A. G. S., white, age 30 years, had indefinite symptoms in the region of the right hip and thigh for one year or more preceding this examination. There had been a stiffness in that region for three months and an occasional limping for six months. One month previously, she had noticed a lump in the region of the right groin. The patient was showing definite loss of weight when she was first seen.

The general physical examination was negative. There was a round, smooth mass beginning at the pelvis and extending down the right thigh for four inches, seemingly anterior to the adductor muscles. The mass seemed to be arising from the ischium. X-ray examination showed a fairly transparent, trabeculated tumor in the adductor region attached to the pelvis, with definite destruction of the ischium. X-ray examination of the chest was negative and operation was not advised. Deep x-ray therapy was given to the pelvis from March 16, 1923, to a few months before the patient's death in February, 1928.

The patient died five years after the date of examination and six years after the onset of symptoms. The exact cause of death is not known, but the family physician reported it as hemorrhage. No tissue was obtained for examination. Judging from the clinical history and the x-ray studies, this is undoubtedly a case of sarcoma arising secondarily in a benign osteochondroma of the pelvis. Unfortunately, no microscopic proof of the diagnosis is available.

Case 4. W. M. O., Jr., age 18 years, sustained trauma to the thigh in November, 1923, in a football game. At first there was only a slight limp, but two weeks later the patient began to complain of an ache, which was worse at night. There was no swelling. Treatment by an osteopath three weeks after the injury was followed by some swelling.

On palpation during physical examination one month after the injury, one felt at the junction of the upper and middle third of the thigh a mass, most marked on the outside, which resembled bone. X-ray examination revealed an area of destruction of cortical bone under an area of new bone formation. The question of sarcoma was raised. The chest was negative. Dr. Bloodgood stated that he had never cured a case of sarcoma above the middle third of the femur and advised deep x-radiation. The patient was given a course of deep irradiation in January, 1924, and another in March. Some months later there was spontaneous opening, with discharge of clear fluid and a sequestrum. The final impression was that we were probably dealing

with a sclerosing periostitis and not sarcoma.

The case has been followed from time to time. In the last report received (April 30, 1931), the lesion is said to be entirely healed and the patient clinically well.

Case 5. Mrs. S. F., age 30 years, was first seen March 1, 1926, when she appeared with a lump in her left breast. Operation was advised, but refused. She went to New York, where the complete operation for cancer was done in August, 1926. The patient returned for deep irradiation, the first course of treatments being administered over the chest in September, 1926. During the following three years, she returned at intervals of from three to six months for further irradiation. Meanwhile, numerous roentgen examinations were made of her chest and skeleton. She received several blood transfusions because at times her hemoglobin and red blood cells were low.

The x-ray films of the chest and skeleton were negative until January, 1928, when suspicious metastatic shadows were found in the right mediastinum. A little later, metastatic shadows were found in the vertebræ, pelvis, and other bones. Her pain was invariably stopped by irradiation so that opiates could be discarded. The patient lived for about three years in relative comfort.

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## A REPORT OF OVER A THOUSAND UNSELECTED CANCER CASES, TREATED IN 1931-1932, AT THE NEW YORK CITY CANCER INSTITUTE, WELFARE ISLAND[1]

By IRA I. KAPLAN, B.Sc., M.D., Director, Division of Cancer, Department of Hospitals, New York City

GENERALLY speaking, the aim of therapeutic efforts in medicine is to produce specifically beneficial results. No matter what the disease, the physician is expected to forestall death and prolong life in comfort. The sole exception seems to be in the case of cancer, and here the public has, unfortunately, been led to believe that from the inception of the disease the patient is doomed, so that not infrequently is the physician requested to do what he can to bring on the inevitable result as painlessly as may be.

What is it that has created this impression in the public mind? No doubt the most important factor has been the failure to identify a definite cause of cancer. The mystery of the unknown has served to add an altogether unnecessary dread to the disease. Due to its insidious growth and the absence of pain in its early stage, most of its victims seek treatment long after the disease has progressed beyond the local area. It is because patients apply for medical assistance late in the disease that their chance for cure is so slight; as a corollary to this inability to offer a cure many cases drift into the clutches of quacks.

As yet no specific remedy has been found for cancer and we have had to confine our methods of treatment to surgery and radiation, which remedies have resulted in at least a moderate number of cures.

The vast number of variations of cancer manifestation has prevented a definite standardization of therapy, whether by surgery or irradiation. While we have progressed considerably in our knowledge of the management of cancer cases, we have not as yet been able to prescribe any particular type of treatment as a curative agent for all condi-

[1]Read before the Radiological Society of North America, at the Eighteenth Annual Meeting, at Atlantic City, Nov. 28-Dec. 1, 1932.

From the Department of Hospitals, Dr. J. G. William Greeff, Commissioner.

Fig. 1. Epithelioma of lower lip treated by surgical excision and neck gland dissection. No irradiation. Recurrence several months later. Patient died.

Fig. 2. Epithelioma of lower lip treated by small dose of interstitial radium, followed by local resection. Recurrence. Patient still living.

tions. Many physicians, however, who are qualified neither by experience nor training, attempt cancer treatment along set lines, disregarding entirely the fact that a clinical understanding of the individual case is required in each instance.

The early enthusiasm that attended the advent of radiation as a new force in therapy of cancer was a source of no little harm in this field. Because in the beginning radiation from radium and x-rays was acclaimed as a universal panacea for cancer, legitimate physicians readily accepted this new form of therapy, while the quacks seized upon it as a heaven-sent, newer, get-rick-quick scheme.

Mistakes in surgery can fortunately be corrected in many instances, and life saved, but errors in radiation therapy rarely can be corrected, the condition in most cases becoming worse and more painful for the victim. Often results of such errors have been so dreadful as even to justify the professional rejection of its employment.

What becomes of patients treated for cancer is a question asked not alone by the general public but by the profession as well. For if the doctor is to learn anything at all about cancer, he must know the results of his treatment of this disease. Only in this way can he avoid the repetition of possible errors, and, as errors in radiation technic often cause extensive destruction of tissue, mistakes in this field of therapy prove tremendously costly.

Not always, in radiation, are the results immediately apparent. By reason of radiation's latent powers, its effects often are delayed over a period of many weeks and the biological reaction may extend beyond the usual period of action and resemble results as seen following surgical procedures. The so-called "Spätschadigen" of the Germans,

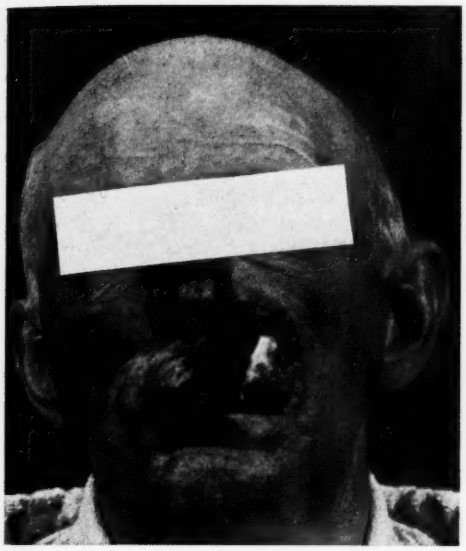

Fig. 3. Epithelioma of upper lip; insufficient radium therapy. Recurrence, with metastasis to neck glands.

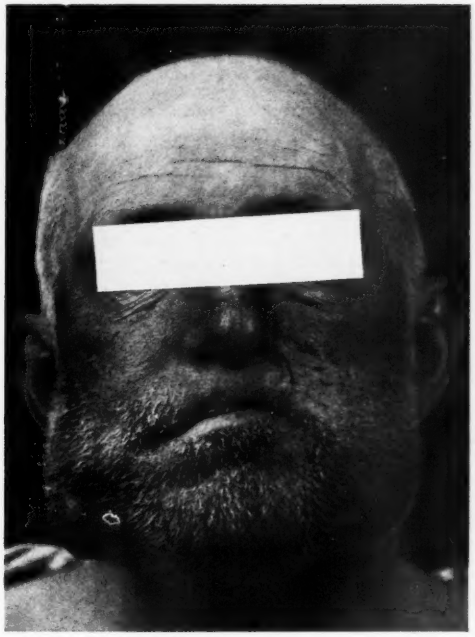

Fig. 4. Epithelioma of upper lip; insufficient radium therapy. Recurrence, with metastasis to neck glands. Post-radium therapy recurrence.

the late reactions or sequelæ of harmful effect, may not appear until many months after treatment has been given.

A full knowledge of the early and late reactions is essential, therefore, in the training of one who would carry on successful cancer therapy. This is possible only if patients can be cared for under proper auspices in an institution specially designed and equipped for such work. The Cancer Hospital on Welfare Island, under the jurisdiction of the Division of Cancer of the Department of Hospitals, City of New York, is an institution of this type. To this hospital come patients from all sections of the city. They are accepted regardless of race, creed, color, or economic status, and whether or not they have previously received treatment elsewhere, either from private physicians or hospitals or from hospitals of the municipal system. In this cancer hospital patients are received in every condition, from the incipient stage of the disease to the most advanced. Old and young, all come to us for care, since cancer is no respecter of age. Here we can judge the results of treatment already given, whether by surgery or radiation, or a combination of both; and here we can see the progression of the disease throughout the body, even though the original, local lesion be entirely eradicated. Every type and method of treatment has been utilized in caring for these patients and much can be learned by a careful study of the work done here.

*Pathology.*—In most cases the pathology was ascertained either by direct biopsy or by information from referring hospitals. Of the 1,236 cases, 240 had had no treatment before coming to our hospital, and the balance (996) had been previously treated elsewhere, by surgery or irradiation or both. No less than 40 per cent of all cases admitted to the hospital received no treatment other than custodial care, owing to the advanced stage of their condition. Of all the cases admitted to the Cancer Hospital, 69 per cent were referred by 26 other hospitals and the rest by private physicians. Of the

latter class of patients, 25 per cent had to be conveyed from their homes, being bedridden or hopeless cases.

The following tabulations show the types of lesions received for treatment and some details of the more important conditions cared for.

*List of Charts.*—1, Total number of cases received and results, January 1, 1931, to September 30, 1932; 2, Mouth and Throat; 3, Gastro-intestinal Tract; 4, Breast Cases; 5, Gynecological Cases; 6, Genito-urinary Cases; 7, Epitheliomas; 8, Hodgkin's Disease; 9, Sarcomas; 10, Type of cases present in the hospital October 25, 1932.

CHART 1-A—A STUDY OF OVER A THOUSAND UNSELECTED CASES DURING JANUARY 1, 1931, TO SEPTEMBER 30, 1932

| | |
|---|---|
| Patients in Cancer Hospital, January 1, 1931 | 186 |
| Patients received from January 1, 1931, to September 30, 1932 | 1,434 |
| Primary admittances | 1,236 |
| Readmittances | 384 |

*Report on 1,236 Primary Cases*

| | |
|---|---|
| 1,048 white | 617 males |
| 180 colored | 619 females |
| 5 yellow | 101 years (oldest) |
| 3 not stated | 11 years (youngest) |

*Diagnosis*

1,125 carcinomas
57 sarcomas
21 Hodgkin's disease
28 benign
5 no diagnosis

*Results*

| | |
|---|---|
| 294 discharged living | 762 deaths |
| 221 in the hospital | 76 autopsies |

*Additional Data on 570 Patients of 1932*

| | |
|---|---|
| 487 married | 223 born in U. S. A. |
| 72 single | 347 foreign born |
| 11 not stated | |

CHART 1-B

| | Total | Improved | Not Improved | Dead |
|---|---|---|---|---|
| *Epithelioma* | | | | |
| Face | 60 | 30 | 6 | 24 |
| Scalp | 3 | 0 | 1 | 2 |
| Skin, various | 3 | 0 | 0 | 3 |
| Neck | 3 | 0 | 1 | 2 |
| *Metastatic* | | | | |
| Origin unknown | 9 | 0 | 5 | 4 |
| *Primary Carcinoma* | | | | |
| Lip | 22 | 7 | 6 | 9 |
| Mouth | 32 | 2 | 5 | 25 |
| Tongue | 60 | 6 | 8 | 46 |
| Palate | 9 | 2 | 3 | 4 |
| Tonsil | 29 | 3 | 5 | 20 |
| Pharynx | 5 | 0 | 2 | 3 |
| Orbit | 1 | 0 | 0 | 1 |
| Antrum | 9 | 2 | 1 | 6 |
| Larynx | 28 | 2 | 7 | 19 |
| Parotid | 2 | 0 | 0 | 2 |
| Bronchus | 4 | 1 | 1 | 2 |
| Lung | 19 | 1 | 4 | 14 |
| Thyroid | 7 | 2 | 2 | 3 |
| Neck | 2 | 0 | 0 | 2 |
| Breast | 148 | 18 | 42 | 88 |
| Esophagus | 34 | 7 | 3 | 24 |
| Stomach | 108 | 5 | 23 | 80 |
| Pancreas | 2 | 0 | 0 | 2 |
| Liver | 3 | 0 | 0 | 3 |
| Gall bladder | 1 | 0 | 0 | 1 |
| Cecum | 6 | 1 | 2 | 3 |
| Colon | 7 | 1 | 2 | 4 |
| Sigmoid | 10 | 1 | 1 | 8 |
| Rectum | 104 | 20 | 22 | 62 |
| Anus | 2 | 0 | 0 | 2 |
| Kidney | 7 | 1 | 5 | 1 |
| Bladder | 28 | 2 | 5 | 21 |
| Urethra | 1 | 0 | 0 | 1 |
| Ovary | 42 | 8 | 9 | 25 |
| Cervix | 212 | 67 | 31 | 114 |
| Uterus | 11 | 4 | 0 | 7 |
| Vagina | 3 | 1 | 0 | 2 |
| Vulva | 5 | 1 | 1 | 3 |
| Penis | 12 | 1 | 1 | 10 |
| Testicle | 2 | 0 | 0 | 2 |
| Teratoma | 3 | 0 | 0 | 3 |
| Scrotum | 3 | 0 | 1 | 2 |
| Prostate | 50 | 6 | 9 | 35 |
| *Metastatic* | | | | |
| Primary unknown | 14 | 1 | 4 | 9 |
| Sarcoma | 57 | 2 | 19 | 36 |
| Hodgkin's disease | 21 | 5 | 7 | 9 |
| Benign tumors | 33 | 14 | 8 | 11 |

CHART 2-A

| | |
|---|---|
| *Lip Cases* | |
| Total number | 22 |
| Males | 22 |
| Females | 0 |
| White | 21 |
| Colored | 1 |
| Married | 19 |
| Single | 3 |

*Ages.*—Youngest, 46 years; oldest, 69 years.

Four cases had had no previous treatment; 15 cases had metastases.

*Results*—Improved, 7; unimproved, 6; dead, 9.

*Comment.*—Some of the most distressing conditions we have had to deal with were the malignancies of the lip. The upper lip was involved in one case only. The pathology in all cases was squamous-cell epithelioma. In seven cases glandular metastases were present. In four cases previous neck dissection, with removal of the local lip lesion, had been performed. In eight cases some type of radium therapy had previously been used unsuccessfully. In one case 57 radium applications had been given to a resistant local lesion. In several instances irradiation healed the local lesion, but failed to prevent extensive metastases. From our observation the cases treated by interstitial

radium therapy did not do as well as those treated by surface radium therapy. In some cases, if operative removal of the bulk of the tumor had been done, subsequent irradiation would have proven more successful.

CHART 2-B

*Mouth Cases*

| | |
|---|---|
| Total number | 32 |
| Males | 32 |
| Females | 0 |
| White | 32 |
| Colored | 0 |
| Married | 31 |
| Single | 1 |

*Ages.*—Youngest, 44 years; oldest, 80 years.
Twenty-three cases had metastases.
*Results.*—Improved, 6; unimproved, 4; dead, 22.

*Comments.*—In most cases the local malignant lesion was associated with bad dental conditions and poor mouth hygiene. In some instances direct injury to the mucosa was easily traced to ragged, infected, filthy teeth. Without exception all these cases were males and all of the white race. The sites of involvement were the floor of the mouth, the alveolar ridge, and the buccal mucosa. In most instances extensive metastatic involvement of the regional lymph nodes was present, and in some, necrosis of bone had occurred. Bone destruction was, in our opinion, due to previous irradiation rather than to malignant extension. Associated syphilis was present in but two cases. Radiation failed in all but two cases. Radiation with surgery gave no successful results. Fifty per cent of the cases were admitted in an advanced condition. Death occurred in most instances from cachexia and starvation.

CHART 2-C

*Palate Cases*

| | |
|---|---|
| Total number | 9 |
| Males | 9 |
| Females | 0 |
| White | 7 |
| Colored | 2 |

*Ages.*—Youngest, 42 years; oldest, 69 years.
*Results.*—Improved, 2; unimproved, 3; dead, 4.

*Comments.*—In our series, this condition affected males only. Most cases exhibited extensive ulcerative growths involving both the soft and hard palates. Surgical removal failed in cases so treated. Metastases were present in all instances. Only two cases improved with local interstitial irradiation.

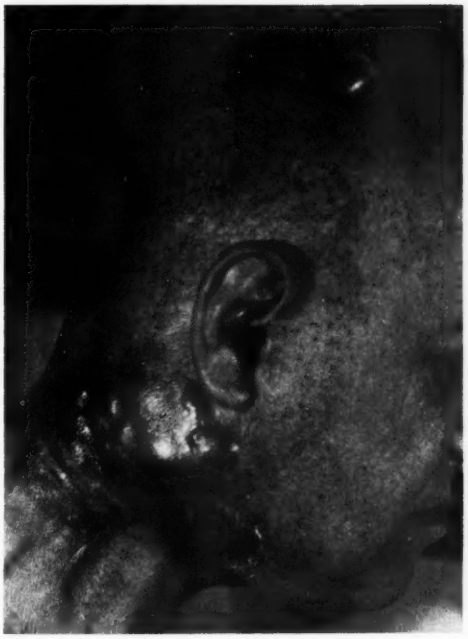

Fig. 5. Epithelioma of tongue, with extensive involvement of base of tongue, tonsil, and pharynx, with neck metastases. External irradiation only; progressive involvement. Death.

CHART 2-D

*Tongue Cases*

| | |
|---|---|
| Total number | 60 |
| Males | 59 |
| Females | 1 |
| Married | 51 |
| Single | 9 |
| White | 58 |
| Colored | 2 |

*Ages.*—Youngest, 36 years; oldest, 101 years.
Fifty-two cases had had previous treatment; 8 cases were never treated.
*Results.*—Improved, 6; unimproved, 8; dead, 46.

*Comments.*—All but seven cases were advanced and the local lesion was associated with bad mouth conditions in all cases. Only six cases had a concomitant syphilis. Metastases were present in all but six cases. The pathology in all cases was squamous-cell epithelioma. Twenty-eight cases had some sort of treatment previous to admission. In six cases surgical removal of the lesion had not hindered the disease. Ra-

Fig. 6. Carcinoma of antrum. Treatment consisted of surgery and radium therapy. Recurrence to neck two years later.

dium therapy employed in most cases was of the interstitial type. In all but six cases irradiation was unsuccessful. In several cases gastrostomy had to be performed for feeding purposes. Death ensued in most cases from cachexia, starvation, and pneumonia. In our opinion, the poor results from irradiation were due to inadequate treatment in the first instance and failure to provide proper mouth hygiene.

CHART 2-E

*Pharynx Cases*

| | |
|---|---|
| Total number | 5 |
| Male | 4 |
| Female | 1 |
| Married | 5 |
| Single | 0 |
| White | 4 |
| Colored | 1 |

*Ages.*—Youngest, 22 years; oldest, 47 years.
*Results.*—Improved, 0; unimproved, 2; dead, 3.

*Comments.*—All our cases were advanced and hopeless. All had had previous treatment of some sort for "nose trouble." Extensive involvement of the pharynx and adjacent tissues precluded any but palliative therapy.

CHART 2-F

*Larynx Cases*

| | |
|---|---|
| Total number | 28 |
| Male | 27 |
| Female | 1 |
| Married | 22 |
| Single | 5 |
| White | 25 |
| Colored | 3 |

*Ages.*—Youngest, 28 years; oldest, 80 years.
*Results.*—Improved, 2; unimproved, 7; dead, 19.

*Comments.*—All but one were males and all but three were in an advanced stage of the disease. Tracheotomy had been performed elsewhere in 15 cases, and four patients required emergency tracheotomy upon admission, one of whom died during operation. In all cases the lesion had extended beyond the larynx, and in 16 cases lymph node metastases in the neck were present. Only four cases had radium therapy, and seven cases had had x-ray therapy elsewhere previous to admission. Treatment at the hospital consisted of tracheotomy in instances in which it was necessary and high voltage x-rays to the neck when possible. Only two cases improved under treatment. Protracted x-ray therapy was not possible in any instance, and x-ray therapy of the regular type failed to check the progressive extension of the disease.

CHART 2-G

*Tonsil Cases*

| | |
|---|---|
| Total number | 29 |
| Male | 25 |
| Female | 2 |
| Not stated | 2 |
| White | 25 |
| Colored | 3 |
| Yellow | 1 |
| Married | 20 |
| Single | 7 |

*Ages.*—Youngest, 33 years; oldest, 85 years.
*Results.*—Improved, 2; unimproved, 5; dead, 22.

*Comments.*—Malignancy of the tonsil occurred in all but two cases in males of the 50-60 age group. Each tonsil was about equally involved, and involvement of both tonsils at the same time occurred in two cases. All patients but one were in an ad-

vanced stage of the disease. Only three cases had had tonsillectomy before admission. The pathology in most cases was squamous-cell epithelioma. All cases were treated with x-ray therapy and 10 had radium applications either interstitially or through a pack. In spite of treatment 22 patients died, of whom only one lived more than a year, the average duration of life of the others being but from two to three months. Only two cases were improved sufficiently to be discharged to their homes. In our opinion these cases were all referred too late for effective treatment. Intensive irradiation in an early stage might have given better results.

CHART 3-A

*Esophagus Cases*

| | |
|---|---|
| Total number | 34 |
| Male | 29 |
| Female | 5 |
| Married | 29 |
| Single | 5 |
| White | 31 |
| Colored | 3 |

*Ages.*—Youngest, 40 years; oldest, 74 years.

Three had had previous treatment; 31 had had no treatment.

*Results.*—Improved, 7; unimproved, 3; dead, 24.

*Comments.*—The esophagus cases represented some of the most pitiful received. In most instances the patients were cachectic, wasted, and dehydrated. Most cases were white, married males over 40 years of age. The most prominent symptoms in all cases were difficulty in swallowing and marked loss of weight. Only three cases had had more than palliative treatment before admission. Diagnosis was made in most cases by x-ray examination. Our study of these cases leads us to conclude that treatment was applied far too late in the course of the disease to produce good results. Favorable results followed only when gastrostomy was performed early and before complete dehydration had occurred. In most instances emergency gastrostomy resulted in rapid death of the patient. Treatment consisted of gastrostomy, forced feeding, and x-ray therapy through the mediastinum. Radium therapy was attempted in a few instances, but the results were not encouraging.

Fig. 7. Epithelioma of tongue and floor of mouth, with neck gland involvement. Insufficient irradiation with gold radon seed implantation. Death.

CHART 3-B

*Stomach Cases*

| | |
|---|---|
| Total number | 108 |
| Males | 80 |
| Females | 28 |
| Married | 91 |
| Single | 17 |
| White | 89 |
| Colored | 17 |
| Yellow | 1 |
| Not stated | 1 |

*Ages.*—Youngest, 28 years; oldest, 80 years.

Fifty-eight cases in advanced stage; 28 cases had metastases; 5 cases were never treated.

*Results.*—Improved, 5; unimproved, 23; dead, 80.

In 1932 there were 46 cases, as follows: 38 Gentiles; 8 Hebrews.

*Comments.*—Involvement of the stomach occurred third in frequency of all conditions treated. Males were affected about four times as often as females. The disease occurred most often in the 40-60 age group. Metastasis was already present upon admission in 50 per cent of the cases. Duration of symptoms varied from one month to ten years. X-ray diagnosis was positive in

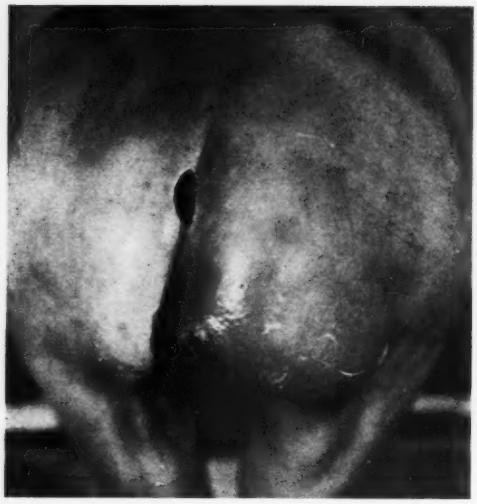

Fig. 8. Carcinoma of rectum. Radical resection. No irradiation. Recurrence, with gluteal extension. Death.

nearly all cases. Some form of previous operation on the stomach had been done in 10 per cent. In several, previous gastro-enterostomy had been performed. In 20 per cent of the cases the condition was so hopeless that no scientific therapy of any kind could be given. In six cases radium therapy and in 20 cases x-ray therapy was administered. In most cases only supportive treatment and custodial care were possible. Operation was performed in 12 cases. Death occurred in most instances from the extension of the local lesion, with cachexia, starvation, and metastases to other organs.

Our study of these cases suggests that in cancer of the stomach early diagnosis and early radical operative procedure are essential to the lowering of the death rate. Irradiation so far in our hands has been of little avail.

CHART 3-C

*Rectum Cases*

| | |
|---|---|
| Total number | 104 |
| Male | 59 |
| Female | 45 |
| Married | 71 |
| Single | 33 |
| White | 98 |
| Colored | 6 |

Fig. 9. Epithelioma of lower end of rectum. Local treatment for hemorrhoids. Extension metastasis to inguinal nodes. Death.

*Ages.*—Youngest, 25 years; oldest, 90 years.
*Results.*—Improved, 20; unimproved, 21; dead, 63.
In 1932, of the 41 cases, 26 were Gentiles and 15 Hebrews.

*Comments.*—This lesion was the fourth in frequency in our series, occurring slightly more often in males than in females. In 80 per cent of the cases some form of operative procedure had been performed previous to admittance to the Cancer Hospital, in most instances, merely a colostomy for emergency relief of obstruction. The pathology in most cases was adenocarcinoma and the site of the lesion in the lower portion of the rectum. Duration of symptoms to the time of admission varied from one week to five years. The most frequent symptom complained of was bloody stools, with diarrhea or constipation. Several patients had had previous treatment for hemorrhoids. Treatment after admittance to the Cancer Hospital in most instances was palliative only: colostomy in seven cases; radium therapy in 20 cases; beside specific therapy in 15 cases, several had x-ray therapy. In several cases previous destructive radical operations had been performed, with increased misery for the patients. Several had received some form of radium therapy before admission to the Cancer Hospital. In most instances

Fig. 10. Extensive carcinoma of breast; no skeletal metastasis; too late for therapy.

Fig. 11. Carcinoma of breast. Radical mastectomy. Recurrence, *en cuirasse* type, six months later. No irradiation.

these cases suffered intense pains from sloughing due to over-radiation, or secondary peritonitis from radiation necrosis or perforation. Radium treatment in most instances was by means of the proctostat (rectal applicator), which eliminates radium necrosis to a great extent and entirely prevents perforation necrosis and associated peritonitis. Death was due in most instances to cachexia and extension of the local lesion.

CHART 4

*Breast Cases*

| | |
|---|---|
| Total number | 148 |
| Males | 8 |
| Females | 140 |
| White | 119 |
| Colored | 29 |
| Married | 124 |
| Single | 24 |
| Pregnancies | 77 |

*Ages.*—Youngest, 22 years; oldest, 78 years.

In 1932 there were 72 cases, as follows: Gentiles, 57; Jews, 15.

*Previous Treatment*

57 had surgery
19 had surgery and x-rays
11 had radium
53 had x-ray
8 had no treatment
113 had metastases
11 in both breasts
67 right breast
67 left breast
3 not stated

*Results.*—Improved, 18; unimproved, 42; dead, 88.

*Comments.*—In our study of these cases several factors were noted. Most cases occurred in females, and most often in those who had borne children. White women were more often afflicted than colored, and the right and left breasts were equally involved. Involvement of both breasts was uncommon. Jewish women were slightly less subject to this type of cancer than Gentiles. The most frequent age of involvement was in the 40-50 year group. The pathology in most instances was adenocarcinoma, next in frequency were the duct cell and scirrhous types.

A study of the methods of treatment showed that surgery was performed in 50 per cent of all cases but in only 25 per cent of these was post-operative x-ray therapy employed. The type of operation varied. In most instances a more or less radical operation was performed; in no instance was a simple mastectomy done. In 90 per cent of these cases death occurred from metastatic involvement, which was so extensive when the patient came to us, a short time after operation, that we were of the opinion

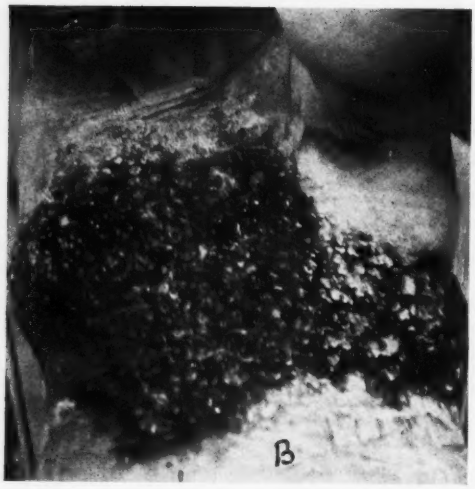

Fig. 12. *En cuirasse* carcinoma following radical mastectomy and post-operative x-ray therapy four years previously.

the metastases must have existed at the time of operation.

A distressing condition of many cases in which radical mastectomy had been performed, was swelling of the arm due in most instances to too extensive surgery. In the 30 per cent of cases with extensive skeletal metastases, only palliative treatment was possible. In many cases, radium and x-ray therapy was employed, but failed to arrest the disease in any instance. From our observations, cases treated with pre-operative irradiation and careful surgery gave the best results. Endothermic surgery was of value in ulcerated, bulky tumor growths, but added no additional assurance against development of metastasis.

CHART 5

*Ovary Cases*

| | |
|---|---|
| Total number | 42 |
| White | 34 |
| Colored | 8 |
| Married | 27 |
| Single | 15 |

*Ages.*—Oldest, 71 years; youngest, 25 years.

In 1932 there were 23 cases, of which 17 were Gentiles and 6 were Hebrews.

*Previous Treatment.*—Twenty-four had been operated upon, and 23 had metastases.

*Results.*—Improved, 8; unimproved, 9; dead, 25.

Fig. 13. Carcinoma of breast. Recurrence and skeletal metastasis following radical surgical mastectomy.

*Comments.*—A study of the cases of ovarian malignancy showed that married women were affected twice as often as single ones, and the incidence among white women was five times that among colored. In most instances the duration of symptoms was 10 months; in one case it was 12 years (this patient improved under x-ray therapy and left the hospital after a stay of three months). In most cases the patients presented a palpable pelvic tumor, associated with ascites. Fifty per cent of the cases had had previous operation. Generalized metastasis was present in 5 per cent of the cases, involving the peritoneum and in a few cases the liver and lungs. Because in most instances the cases referred to the Cancer Hospital were in an advanced stage of the disease, treatment consisted in palliation

with x-rays and symptomatic surgery for the removal of accumulated ascitic fluid. The best results were achieved by x-ray therapy, operative removal of the bulk of the tumor, and additional x-ray therapy.

CHART 5-A

*Uterus Cases*

| | |
|---|---|
| Total number | 11 |
| White | 9 |
| Colored | 2 |
| Single | 1 |
| Married | 10 |
| Pregnancies | 8 |

*Ages.*—Youngest, 40 years; oldest, 75 years.
*Results.*—Improved, 4; dead, 7.

*Comments.*—All but one case were married women but only eight of these had borne children. In two cases previous hysterectomy had been done for supposedly benign bleeding and the malignant diagnosis made post-operatively. Most cases were in the 50-60 year age group. Post-menopause bleeding was the most common complaint. Many of the cases were far advanced in the course of the disease, and in some only a diagnostic curettement with radium in the uterus for controlling the bleeding was the therapy used. High voltage x-rays through the pelvis controlled the bleeding in some cases. Metastasis in the pelvis was present in most instances; in one case the metastasis was in the lungs. In seven cases death approached progressively in spite of irradiation.

CHART 5-B

*Cervix Cases*

| | |
|---|---|
| Total number | 212 |
| White | 149 |
| Colored | 63 |
| Married | 203 |
| Single | 6 |
| Pregnancies | 9 |
| Not stated | 54 |

*Ages.*—Youngest, 23 years; oldest, 80 years.

*Comments.*—In no instance was an early case of cancer of the cervix received at the Cancer Hospital, while in most instances the condition was well advanced. The disease occurred mostly in white Gentile women, nearly all of whom were married and had borne children. In 16 cases a previous hysterectomy had been performed and malignancy developed in the post-operative stump of the cervix or cervico-vaginal wall. A concomitant syphilis was present in 20 per cent of the cases. Previous treatment given in all but 25 per cent of the cases was irradiation of one kind or other. The pathology in most instances was squamous-cell epithelioma, plexiform next, and adeno-carcinoma only in 11 cases. Treatment at the Cancer Hospital consisted of intensive vaginal hygiene, transfusions in cases in which it was necessary, and irradiation by high voltage x-rays and radium. Surgery for relief of local infections was employed in few instances. Death was due in most cases to malignant extension to the pelvis, with associated infection.

Fig. 14. Double radical mastectomy; one-year interval between operations. Post-operative x-ray therapy; metastasis to skull; blindness in one eye. Death.

Fig. 15. Carcinoma of prostate. Operation; recurrence; metastasis to pelvic bones and skin (proven by biopsy).

CHART 6

*Bladder Cases*

| | |
|---|---|
| Total number | 28 |
| White | 26 |
| Colored | 2 |
| Male | 19 |
| Female | 9 |
| Married | 23 |
| Single | 5 |

*Ages.*—Youngest, 34 years; oldest, 82 years.
*Results.*—Improved, 2; unimproved, 5; dead, 21.

*Comments.*—All cases had been previously operated upon, and most of them were hopeless upon admittance. Previous operations consisted of simple suprapubic cystotomy for obstruction, resection of tumor, cauterization of the local bladder lesion, and in some cases radium implantation into the local growth. In only a few cases was radiation therapy possible and high voltage x-rays were employed for this purpose. Failure in these cases was due in most instances to late diagnosis and lack of early supportive irradiation.

CHART 6-A

*Prostate Cases*

| | |
|---|---|
| Total number | 50 |
| White | 44 |
| Colored | 6 |
| Porto Rican | 1 |
| Married | 40 |
| Single | 10 |

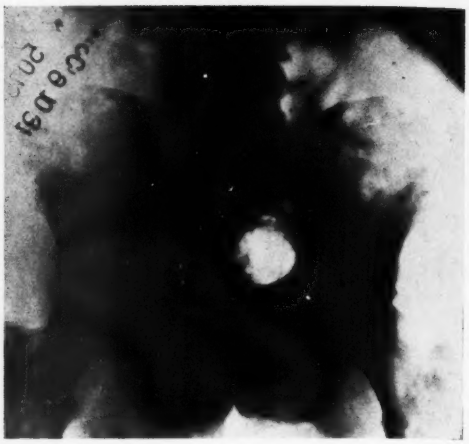

Fig. 16. Carcinoma of prostate, showing metastasis to pelvis.

*Ages.*—Youngest, 50 years; oldest, 74 years.
*Results.*—Improved, 6; unimproved, 9; dead, 35.
Eighty per cent had metastases proven by x-rays.
In 1932, of 23 cases, 20 were Gentiles and three were Hebrews.

*Comments.*—This lesion was seldom found in the Negro race. Concomitant syphilis was rare. Skeletal metastasis was present in 80 per cent of the cases. Suprapubic cystostomy had been performed in all but a few cases before admission and in the latter after entering the hospital. In only a few instances had radium therapy been employed before admission. Severe skeletal pains and cachexia were pronounced in most cases. In five cases radium therapy and in 40 cases x-ray therapy was employed. Only six cases were improved and, in our opinion, this improvement was due to a combination of surgical relief of immediate local blockage and intensive generalized x-ray therapy to the pelvis.

CHART 6-B

*Penis Cases*

| | |
|---|---|
| Total number | 12 |
| White | 10 |
| Colored | 2 |
| Married | 8 |
| Single | 4 |
| Gentiles | 12 |
| Hebrews | 0 |

*Ages.*—Youngest, 32 years; oldest, 73 years.
*Results.*—Improved, 1; unimproved, 1; dead, 10.
All had had surgical removal of the lesion previous to admittance to the Cancer Hospital.

*Comments.*—In no case of carcinoma of the penis was the Wassermann positive. In some cases dissection of the regional nodes was done. High voltage x-ray therapy was used in all cases and local radium applicators were employed in several. Only two patients survived, 10 rapidly succumbing to secondary infection and metastases.

CHART 7

| | |
|---|---|
| *Epitheliomas* | |
| Total number | 78 |
| Distribution | |
| Face | 60 |
| Scalp | 3 |
| Skin (various) | 3 |
| Neck | 3 |
| Metastatic (origin unknown) | 9 |
| Males | 50 |
| Females | 28 |
| White | 75 |
| Colored | 2 |
| Yellow | 1 |

*Ages.*—Youngest, 20 years; oldest, 85 years.
*Results.*—Improved, 30; unimproved, 13; dead, 35.

*Comments.* — Surface epithelioma occurred in most instances in the 50-70 years age group. The most frequent site of superficial epithelioma was on the face. Pathologically, the usual form was basal-celled. Frequently the lesion started as a small ulceration or keratotic wart. In two instances malignancy developed on an old lupus which had been persistently and frequently treated with x-rays. In spite of the seemingly mild malignancy of the basal-cell type of epithelioma, some of the most destructive lesions were in this group and persisted in spite of treatment by x-rays, radium, or surgery. In most instances the lesion had been over-irradiated. A study of this type of case suggested that the initial treatment failed because it was not intensive enough, and subsequent irradiations produced more and more necrosis, associated with radiation vaccination. In one case malignancy and ulceration followed excessive exposure to diagnostic x-rays. In another, the malignancy developed following excessive x-ray treatments of keloids on a severe burn. In most instances death followed extensive destruction of the skin and adjacent structures. The colored race is seldom affected by this type of lesion.

Fig. 17. Epithelioma of scrotum, with metastasis. Progressive growth in spite of x-ray therapy. Death.

CHART 8

| | |
|---|---|
| *Hodgkin's Disease* | |
| Total number | 21 |
| Male | 17 |
| Female | 4 |
| Married | 19 |
| Single | 2 |
| White | 21 |
| Colored | 0 |

*Ages.*—Youngest, 26 years; oldest, 73 years.
*Results.*—Improved, 5; unimproved, 7; dead, 9.

*Comments.*—All cases were in an advanced condition of the disease, most of them having been admitted because of general weakness. Positive biopsy was had in every case. Most often the condition exhibited a generalized swelling of the lymph glands of the neck, axillæ, and inguinal areas. There were two cases of abdominal Hodgkin's. Several had associated enlargement of the spleen and mediastinal nodes along with generalized superficial adenopa-

Fig. 18. Epithelioma of face, treated by radium, x-rays, and plastic surgery; persistent recurrence and necrosis; loss of ear. Death.

thy. One case showed Hodgkin's nodules in the skin along with involvement of bone. All but one case were treated with high voltage x-ray therapy, some requiring additional supportive treatment by blood transfusions. Treatment was effective in those cases that received protracted multiple doses of x-rays over a long period of time. The one case not treated was too far gone for any therapy.

CHART 8-A

| *Thyroid Cases* | |
|---|---|
| Total number | 7 |
| Male | 3 |
| Female | 4 |
| White | 6 |
| Colored | 1 |
| Married | 7 |
| Single | 0 |

*Ages.*—Youngest, 41 years; oldest, 69 years.

*Previous Treatment.*—One had had radium therapy; 6 had had operation; 2 had had x-ray therapy.

*Results.*—Improved, 2; unimproved, 2; dead, 3.

*Comments.*—Malignancy of the thyroid occurred almost equally in the two sexes. Diagnosis was made in all cases by biopsy. Six patients had had previous partial thyroidectomy. In one case only could palliative irradiation be employed. In two cases x-ray therapy was used following operation. All patients were treated at the Cancer Hospital with x-ray therapy, of whom only two were improved. In our opinion pre-operative x-ray therapy might have produced better results, as it has done in our other clinics where this method has been pursued.

CHART 9

| *Sarcomas* | |
|---|---|
| Total number | 57 |
| Types | |
| Melanosarcoma | 4 |
| Myosarcoma | 3 |
| Fibrosarcoma | 10 |
| Myxosarcoma | 1 |
| Lymphosarcoma | 13 |
| Osteochondroma | 1 |
| Bone sarcoma | 20 |
| Uterus—sarcoma | 3 |
| Cervix—sarcoma | 1 |
| Liver—sarcoma | 1 |
| *Bone Sarcoma* | |
| Skull | 1 |
| Jaw | 1 |
| Antrum | 1 |
| Rib | 1 |
| Humerus | 2 |
| Ilium | 3 |
| Femur | 7 |
| Tibia | 2 |
| Foot | 2 |

*Results.*—Improved, 2; unimproved, 19; dead, 36.

*Comments.*—The most frequent type of sarcoma seen in our series was osteogenic bone sarcoma. Diagnosis was made in most cases by the roentgen examination, confirmed in some instances by operation, either simple exploratory or amputation. Pathological fracture occurred in several cases, especially cases in which the femur was involved (7 instances). In some cases irradiation stayed for a short period of time the progress of the disease. In most cases, however, it was not effective nor was sur-

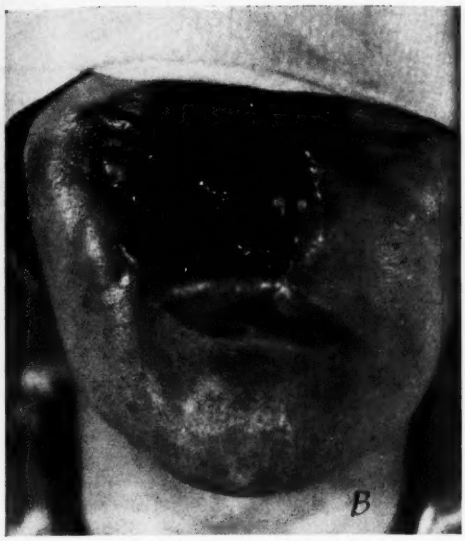

Fig. 19. Epithelioma of face, treated by repeated x-ray doses; recurrence; repeated x-ray and radium treatments; extensive persistent necrosis; radiation. Death.

gical interference possible. Of the 20 patients, 14 died soon after treatment had been instituted, while the others remained unimproved.

The 13 cases of lymphosarcoma were all proven by operation. The most frequent type of involvement was that of the cervical lymph nodes (5 cases); inguinal and retroperitoneal nodes (2 cases each), and the back, tonsil, intestine (1 each). There was one case of generalized lymphosarcoma. All but one patient were over 35 years of age, and all were in advanced stages of the disease when admitted to the Cancer Hospital. The intestinal case was a white male, aged 37, and the lesion involved the small intestine, which had been resected. X-ray therapy was employed in all cases but gave only temporary relief. Of the 13 cases, 10 died.

Irradiation for fibrosarcoma was only slightly effective, because patients were referred for this form of treatment in an advanced stage of the disease following operation for removal of tumor growth. Most lesions involved the fascia of the back.

Fig. 20. Epithelioma of skin—unusual epithelioma of face and hands. Persistent extension in spite of radium therapy.

Myosarcoma in two cases involved the nose; both were operated upon. The third case involved muscle of the face. X-ray therapy was used post-operatively in all cases, with little effect.

The three cases of uterine and one case of cervical sarcoma were diagnosed only following curettage. All four cases were ad-

Fig. 21. Hodgkin's disease; progressive involvement in spite of extensive and persistent x-ray therapy. Death.

vanced and died in spite of intensive irradiation.

The melanosarcomas involved the eye in two cases, and the skin in two cases. Surgical interference plus irradiation was unsuccessful in controlling the eye lesions. The skin cases involved the limbs, with generalized metastases. Irradiation was of no avail in any of the cases.

Fig. 22. Melanosarcoma of foot; metastasis to inguinal area. Recurrence following local removal and cauterization. Death.

CHART 10.—PATIENTS IN CANCER HOSPITAL, OCTOBER, 1932

| | |
|---|---|
| Epithelioma, scalp | 2 |
| Epithelioma, forehead | 1 |
| Epithelioma, face | 4 |
| Malformation, face | 1 |
| Cancer, skin | 1 |
| Epithelioma, skin (abdomen) | 1 |
| Cancer, cervical gland | 1 |
| Burn of neck | 1 |
| Epithelioma, lip | 7 |
| Epithelioma, cheek | 6 |
| Epithelioma, mouth | 5 |
| Epithelioma, tongue | 5 |
| Luetic ulceration, tongue | 1 |
| Mixed tumor, left parotid | 1 |
| Cancer, antrum | 2 |
| Cancer, mandible | 1 |
| Cancer, pharynx | 2 |
| Cancer, tonsil | 1 |
| Cancer, larynx | 6 |
| Cancer, thyroid | 2 |
| Cancer, lung | 2 |
| Cancer, breast | 29 |
| Cancer, esophagus | 3 |
| Cancer, stomach | 11 |
| Cancer, colon | 1 |
| Cancer, sigmoid | 2 |
| Cancer, rectum | 20 |
| Cancer, anus | 1 |
| Rectal fistula | 1 |
| Rectal abscess | 1 |
| Cancer, ovary | 5 |
| Cancer, uterus | 1 |
| Cancer, cervix | 40 |
| Cancer, vulvæ | 1 |
| Cancer, bladder | 5 |
| Cancer, prostate | 14 |
| Cancer, scrotum | 1 |
| Cancer, testicle | 1 |
| Epithelioma, penis | 3 |
| Hyponephroma | 1 |
| Osteosarcoma, face | 1 |
| Sarcoma, femur | 1 |
| Hodgkin's disease | 2 |
| Kaposis disease | 2 |
| Mycosis fungoides | 1 |
| Tumor, brain | 1 |

In the preparation of the statistical figures cited in this study I had the valuable assist-

ance of Dr. Caroline R. Martin, to whom my grateful thanks are due.

### CONCLUSIONS

This study has emphasized that cancer, as an important cause of death, leaves no race immune from it. From the study of special types of certain classes of cancer among races, for example, cancer of the cervix is infrequently found among Jewish women, and cancer of the skin, mouth, and tongue quite uncommon among the colored race. Few men have cancer of the breast.

We also find that the control of cancer depends on how early the condition is diagnosed, and how soon appropriate treatment is instituted. To be effective, treatment, whether surgery or irradiation or a combination of both, must be intensive and must be properly administered at the outset. Secondary treatments are seldom effective.

In order of frequency in our series, malignancy involved the different organs of the body as follows: Cervix, 17 per cent; breast, 11.9 per cent; stomach, 8.7 per cent; rectum, 8.4 per cent; tongue, 4.8 per cent; face, 4.8 per cent; prostate, 4 per cent; ovary, 3 per cent; esophagus, 2.1 per cent. The other organs were less frequently involved.

A large properly organized custodial hospital is necessary for the care of cancer patients and when so established may succeed in improving many cases committed to its care.

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## THERAPEUTIC FEVER PRODUCED BY DIATHERMY[1]

### ITS PRESENT DEVELOPMENTS AND FUTURE POSSIBILITIES

By J. CASH KING, M.D., MEMPHIS, TENNESSEE

BEFORE discussing the diathermic method of producing therapeutic fever, it will be necessary to consider in a general way some of the facts pertaining to fever itself.

Fever is a reaction within the body characterized by certain symptoms and signs, the most outstanding of which are an elevation of the general body temperature and an increased metabolic rate. These reactions represent an imbalance of those physical and chemical mechanisms which maintain the normal temperature of the body in health. The physical operates through the sympathetic nervous system, controlling heat dissipation from the body by its vasomotor effect on the peripheral arterioles. The chemical increases or decreases the amount of heat production through metabolic processes.

### BENEFICIAL EFFECTS OF FEVER

Within the last decade, medical science has recognized that pyrexia is a defense reaction which protects the body against injurious agents by facilitating the production, and hastening the action, of substances or specific antibodies found in the body that combat bacteria and their toxic products. It is apparent that other factors are also at work in induced pyrexia. Sustained high temperature causes peripheral vasodilatation, and has a direct thermic effect on the causative infectious organisms.

Rolly and Meltzer (1), as well as others, have found that animals kept at a high temperature in a thermostat room develop a much more effective defense against intoxi-

[1]Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

cations and infections than those left outside at ordinary temperatures. By injecting small doses of bacteria or toxins as they occur in diseases, the heated animals show many advantages over the controls by living longer; many of them survive doses that inevitably kill the control animals.

It is true that infectious diseases, accompanied by rise of temperature, are self-limiting. On the other hand, it is equally evident that afebrile infections are not self-limiting. Syphilis, gonorrheal infections, and the arthritides are included in this category. Efforts to control these with artificial fever produced by diathermy have met with noteworthy success.

Repeated experiments by Bessemans (*2*) have proved that temperatures of 40° C. for two hours, or 42° C. for one hour, have an intense destructive action upon emulsions of active syphilitic virus, prepared from specific lesions of animals or man. If the syphilitic testicles of rabbits are treated with heat in the form of a continuous bath at these temperatures, the orchitic primary manifestations of syphilis are cured with certainty, without apparent danger to the organ or the general organism. The treponema become immobile and disappear after 24 hours or more, and the tissues of the organ rapidly resume their normal microscopic aspect.

According to the work of Corbus and O'Connor, reported by Pugh (*3*), higher temperatures—from 46 to 47° C.—for from 20 to 40 minutes are necessary for the destruction of the gonococcus, either *in vivo* or *in vitro*.

## METHODS OF INDUCING THERAPEUTIC FEVER

You are already familiar with most of the methods of inducing fever used in the past; for this reason they will not be discussed in detail here. Among these may be mentioned malarial inoculation, infection of the patient with rat-bite fever and relapsing fever, and injection of foreign proteins, vaccines, and other toxic substances.

Some of the chief objections to these procedures are:

1. They necesitate giving the patient a disease which may be difficult to cure, and, in some instances, do irreparable injury to the vital organs of the body.

2. The desired strain of plasmodia, or other infectious agent, often is not available.

3. In many cases, the febrile paroxysms stop spontaneously before the desired reaction is produced. Others may have only slight elevations in temperature, rather than the typical febrile paroxysms.

4. One has no means of controlling the intensity and severity of the febrile attacks without stopping them altogether.

5. Medicinal treatment and some of the febrile diseases cannot be used simultaneously.

6. They offer no means of producing localized temperature of sufficient intensity to kill organisms such as the gonococcus.

In an effort to overcome these difficulties, a new method of inducing therapeutic fever has been presented in the last three years. I refer to hyperthermia, induced by the high frequency diathermy machine, a form of treatment devised by H. D. Roop and the author in 1928. It was first employed in the treatment of paresis at the Western State Hospital in Bolivar, Tennessee, by Dr. E. W. Cocke and the author (*4*) and the results and technic were reported in 1929. As the technic has been somewhat modified since our first report, I feel that it should be reviewed at this time.

### TECHNIC

A diathermy machine of the vario-frequency type, capable of producing and maintaining a load of 10,000 ma., is essential. The high capacity machines make it possible to bring about the desired elevation in temperature in much shorter time, with less dis-

comfort to the patient. The refinement of control permits the duplication of temperature curves. By the use of a special voltage divider, constructed by H. D. Roop, two patients can be treated at the same time, which reduces the time and expense to almost one-half.[2]

The electrodes must be as large as possible, must fit snugly to the skin surface of the patient, and should be placed so that the distance between the anterior and posterior electrodes is equal at all points. Our electrodes, which almost completely cover the anterior and posterior surfaces of the torso, are held in place by a jacket fastened with elastic straps. It is not necessary to use any conductive material on the electrode surface.

Treatment is carried out by placing the patient in bed, carefully applying the electrodes, and then insulating the body and extremities against heat dissipation by wrapping him thoroughly in rubber sheets and blankets. Rubber sheets are required because of the profuse sweating that occurs during the treatment. Since the patient experiences considerable discomfort when the temperature reaches 102 or 103° F., from 3 to 6 gr. sodium amytal per rectum are given immediately preceding treatment. If at any time during the treatment other sedatives are necessary, we advise the use of an H.M.C. tablet No. 1, rather than morphine sulphate alone, because of the depressing effect which the latter has on respiration.

The current is gradually increased to reach from 5,000 to 7,000 ma. by the end of 15 minutes. This milliamperage is maintained until the temperature is within one degree of the desired elevation, and the current is then cut off. The rise is slow at first, but 104° F. is usually reached by the end of one hour. The temperature, pulse, and respiration are recorded before the treatment is begun, each 15 minutes during the contact of the current, and thereafter until the temperature returns to normal. Thorough wrapping of the patient prevents any appreciable fall in the temperature during a period of two hours after the current is cut off. However, if a fall does occur, the current can again be turned on for short periods. To lower the temperature of the patient, all or part of the insulation may be removed.

[2]An illustration of this device appeared in an article by J. F. Hamilton, "The Super-power Diathermy Machine with an 'Output Divider,'" RADIOLOGY, January, 1932, XVIII, 133–135.

### PATHOLOGIC PHYSIOLOGY OF PYREXIA

When the heat-producing currents are passed through the highly vascular tissues of the chest and abdomen, the temperature of the blood in these regions is elevated. As the heated blood reaches the heat-regulating centers of the brain, the latter attempt cooling of the blood through the physical regulatory processes. Marked dilatation of all peripheral vessels occurs, the skin becomes very hyperemic, and sweating is profuse. Dissipation of the heat is prevented by the body insulation. As a consequence, the blood returns at a higher temperature than normal, only to be reheated and again circulated. The increased pulse rate further augments dilatation of the peripheral vessels, with increased rate of blood flow to and from the heart. After a certain degree of fever is induced, the increased metabolism, with general augmentation of the chemical processes in the body, materially assists in heat production, as is shown by the continued rise in temperature after the current is cut off. In other words, a recapitulation of the history of events which occur in infectious disease characterized by pyrexia is enacted and maintained. The essential difference between the vascular reactions of the two is principally quantitative.

*Syphilis.*—Thermic fever produced by diathermy has been used in all forms of syphilis, but more extensively in the treatment of paresis. The lesions in syphilis repeat the essential pathology of the primary lesion,

the hard chancre. These changes are predominantly vascular and perivascular, consisting of lymphoid and plasma-cell infiltrations. The ischemia produced by the reduction in the caliber of the lumina of the vessels ultimately results in chronic fibrosis, which is the chief end-result of all syphilis (5). These treatments combat syphilis, not only through the spirocheticidal effect of heat upon the organisms, encased as they are in fibrous connective tissue, but they also alter the pathologic changes themselves by sustained vasodilatation, which increases the blood supply to the ischemic area.

Since febrile reactions have been most successfully used in paresis, our initial application of hyperthermia was in this disease. The results in our first series of cases were better than those obtained with the use of malarial injections, and our subsequent cases, as well as those reported by others, have shown an increasingly greater percentage of remissions. By averaging all of the cases reported to date, we note that 38 per cent have shown remissions.

The treatment has been employed with equal success, but less extensively, in other forms of neurosyphilis.

In an effort to render the treatment more effective, and possibly to offer a complete cure for the disease, we recommend intravenous antisyphilitic medication just preceding the febrile reaction. When used together, hyperthermia, vasodilatation, and medication within the blood stream augment each other without any additional toxicity. That is to say, the specific drug is brought in better contact with the seat of most active pathology by virtue of the vascular dilatation, and, in this way, the drug has access to the causative organisms at a time when the resistance of the latter is already lowered by the elevated temperature. Any febrile reaction caused by the antecedent medication is observed during the routine recording of temperature.

*The Arthritides.*—In the arthritides, Pemberton (6) has shown that the temperature of the peripheral tissues, particularly of the extremities, is subnormal, due to impaired circulation through the capillary bed in these tissues. He has demonstrated the effect of impaired circulation on bony structures by experiments on dogs. After tying off the blood supply to the patella, he observed changes in this bone similar to those occurring in arthritis. A lowered basal metabolic rate, averaging minus 20, accompanies arthritic changes in the joints. Diathermic fever, by increasing the blood flow through the capillary bed and inducing a high metabolic rate, directly antagonizes the incident pathologic process. Our work with diathermy in this disease, both in chronic hypertrophic and atrophic cases, has been rewarded with most striking results. Every patient has noticed some relief of pain, an increased motion of joints, improved color of skin, and a state of general well-being. When recurrences have been observed after a quiescent period of three months or longer, we believe they have been caused by too prolonged intervals between the treatments. We advocate the continued use of treatments long after complete relief has been obtained, and a gradual increase of the length of time between treatments. Other established therapeutic measures should be combined with this procedure.

*Gonorrheal Infections.*—Heat is one of the oldest forms of therapy for gonorrheal infection. Until recently, however, few, if any, cases have been cured by heat alone. It must be remembered that, in this disease, elevations of the general body temperature are insufficient; to destroy the gonococcus, they must be supplemented by a localized thermic fever of from 46 to 47° Centigrade. Duncan (7) has described the most useful means of inducing local temperature of this intensity; its success is dependent upon the size and arrangement of the indifferent or body electrodes. This method is somewhat similar to that of electrode application in

general diathermic fever. The active electrode for introduction into the urethra, cervix, or fornices, is small, and of the Chapman, Corbus, or Peacock type. A thermophore is provided for a thermometer, so that an accurate temperature may be maintained and observed. The method is more suitable for the treatment of gonorrhea in the female. Unfortunately, in the male, the sensitivity of the urethra will not permit of a temperature of sufficient intensity to accomplish the desired end-result.

*Thrombo-angiitis Obliterans.*—The principal objection to foreign proteins, as used by most therapists in the treatment of this disease, is that the associated chills and vasoconstriction cause the patient much pain and are conducive to thrombosis. Diathermy offers the best means of inducing therapeutic fever in this condition by dilating the capillary bed to the fullest extent without an initial vasoconstriction. Consequently, relief of pain, claudication, and healing of superficial ulcers occur without risk of serious complications.

*Bronchial Asthma.*—Leopold and Stewart (8), Miller and Piness (9), and Feinberg, Osborne and Afremow (10) have observed that, in chronic bronchial asthma, intercurrent febrile reactions of a certain intensity frequently produce complete clinical remissions which last throughout the fever and for some time afterward. These authors have reported 31 cases in which they induced febrile reactions with diathermy in an effort to bring about similar clinical remissions without the use of infective agents. The results have been encouraging, but in all cases they were not equal to those observed in intercurrent febrile diseases. In many, the height, duration, and frequency of the induced fever reactions did not simulate the temperature curves observed in disease, nor were they wholly in accord with the diathermic treatments usually employed. The improvement seen in these cases was, perhaps, due to the effect of diathermy on the sympathetic nervous system, which brought about dilatation of the bronchioles, and probably altered the sensitivity to certain substances. It is hoped that the proper temperature curves will be found on further study, as well as those types of cases in which the treatment is most effective. Thus, another useful agent to combat this prevalent and dreaded disease may be perfected.

*Multiple Sclerosis.*—In a recent publication, Schmidt and Weiss (11) report their observations with diathermic fever in the treatment of sub-combined degenerations, encephalitis, and multiple sclerosis. They state that probably their best results were obtained in multiple sclerosis, in which such symptoms as spastic paraplegia, intention tremors, ataxia, and vesical disturbances were remarkably improved. Other signs, such as scanning speech, nystagmus, and optic atrophy, were not markedly benefited. They observed remissions that simulated, or might prove to be, a cure, and their results in this disease far exceeded their expectations. Achievements in the other two mentioned conditions were less encouraging.

*Chorea.*—Since Sutton (12) reported gratifying results obtained in the treatment of chorea by induction of fever with vaccines, this disease also may be added to the list of those which may be amenable to diathermic therapy.

## SUMMARY

1. The value of febrile reactions as a therapeutic measure can no longer be denied.

2. The appreciation of the ultimate consequences of this form of treatment is dependent on one's knowledge of the physiologic changes produced by hyperthermia, as well as an understanding of the pathology of the disease to which heat is applied.

3. The diathermic method has many advantages over other procedures previously used to bring about the desired febrile reactions. Better results have been made pos-

sible by the improvement in apparatus and technic.

4. The results obtained with diathermic fever in paresis indicate that it is the treatment of choice at the present time. Pyrexia causes profound dilatation of the arterioles and capillary bed, which are the seat of the most active pathologic changes in syphilitic infections. By giving intravenous anti-syphilitic medication immediately before diathermy, we are able to combat the disease at a time when its pathologic processes are altered and the resistance of the treponema is lowered by the high temperature. Thus we hope to cure the disease in its incipiency, or at least to prevent the serious complications of latent syphilis.

5. The improvement observed in chronic arthritis so far has been most encouraging. We attribute this to the changes in the existing pathologic process brought about by the reactions to fever.

6. In gonorrhea, diathermy combats the progress of the disease by the bactericidal effect of heat and through the increased vascularity, which hastens resolution of chronic processes. The proper application of the treatment in the female has brought gratifying results, but thus far its use in the male has not been so encouraging.

7. Although a distinct improvement in symptoms is to be derived from the use of diathermy in the treatment of thromboangiitis obliterans, bronchial asthma, multiple sclerosis, and chorea, the results obtained up to now are not commensurate with those secured in the above-mentioned diseases. We are hopeful, however, that future developments in technic will contribute to a greater success.

## CONCLUSIONS

Therapeutic fever produced by diathermy has proved a valuable aid in the management of a number of diseases. The ultimate accomplishments of this form of therapy, which is still in its infancy, will depend upon close study and conservative reporting of results.

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## DISCUSSION

Dr. W. W. Robinson (Memphis, Tenn.): Diathermy, with the superpower, vario-frequency machine, offers a method of heat production deep within the tissues, under a refinement of control, which is almost perfect, and by means of which the exact type of temperature curve for each individual can be duplicated at will. There is no danger of blistering the skin, for two reasons. First, the resistance for a given voltage with this type of machine is much less than in other types. This

not only prevents sparking from electrodes to skin, but also permits the operator to raise the current rapidly to its maximum. Secondly, due to the large size and distribution of the electrodes, only one-half of the recommended milliamperage is applied per square inch of active electrode surface. This safety factor minimizes the risk of burns in the hypertensive cases and reduces the possibility of syncope in the hypotensive. No specialized skill is essential to the proper use of the machine, as trained technicians can operate it satisfactorily.

The results obtained to date in the treatment of syphilis, especially paresis, are commensurate with those secured from malarial inoculations. While the technic of the malarial injections is quite simple, it is not always the simplest procedure which is the best. Once established, collateral infections are sometimes quite difficult to abolish. It must be emphasized that the injection of viable pathogenic organisms of any character to induce pyrexia in afebrile diseases is hazardous. Pilcz reported 141 cases of paresis treated by malarial inoculation during 1919 and 1920, with 51 complete remissions. However, 15 of the patients died under treatment. The mortality from the use of diathermy is almost negligible. Moreover, atypical febrile reactions, such as may occur from malarial treatment, are of no benefit in the destruction of spirochetes in the body, encysted as they are by fibroblastic proliferation.

In conclusion, while the use of thermic fever in the treatment of thrombo-angiitis obliterans, bronchial asthma, and multiple sclerosis is yet in the experimental stage, I must say that chronic rheumatoid arthritis and gonorrheal infections, the latter in the female, are quite amenable to pyretotherapy, and the results obtained are second only to those in neurosyphilis itself.

Dr. Lewis G. Allen (Kansas City, Kan.): I have had no personal experience with this type of endeavor. One of our group has been doing some work and for that reason I would like to ask Dr. King a question.

Regarding the application of the two electrodes to patients of varying habitus, it struck me that the electrode applied to the chest of the patient with a scaphoid abdomen was much further away than the electrode applied to the abdomen. At least, I have argued with my associates that there should be some difference in the size of the two electrodes or a resistance cut in between the upper and lower electrodes, to compensate for the difference in thickness of the patient's abdomen in comparison with the thickness of the chest. Likewise, it would appear, from the technical standpoint at least, that, in the patient with the large abdomen, the electrodes applied to the abdomen would be further away than those applied to the chest. Are these factors of significance?

Is the criterion of a falling blood pressure incident to the inception of the high temperature of as great importance as has been reported?

Dr. C. E. Piersall (Reno, Nev.): I want to ask how long it takes to get results in chorea, which I have seen clear up by use of the ordinary diathermy machines.

I noticed in Palo Alto, Calif., a new type of diathermy machine which is made with thermionic tubes. I cannot tell you the way it is hooked up, but there is no spark gap or frequency. It produces a very smooth current and you can run the current higher than with the ordinary high capacity diathermy machine and very quickly.

A machine of this type is being used by Dr. Powers, of Palo Alto, which may be something to prove of interest to all of you in the future.

Dr. King (closing): Skin burns produced by electrodes have not been a troublesome factor in our own work since we began the use of extremely large electrodes. However, I do know that these burns still occur occasionally with some users of this form of treatment. They can be avoided if the anterior electrode is made as much as 25 per cent larger than the posterior electrode and if care is used in applying the electrodes to the body of the patient.

Another point in technic that I want to emphasize is the necessity of careful observation of the patient, with frequent checks on the temperature, pulse, and respiration at all times

during the fever reaction and until the temperature returns to normal. If this precaution is not observed—that is, if frequent checks of the temperature are not made after the current is cut off and until the temperature returns to normal—sooner or later serious accidents will occur.

The fall in blood pressure observed during the treatment is undoubtedly due to the dilatation of the peripheral arterioles, which decreases the resistance of the blood flow through the capillary bed.

I, personally, have not had any experience with febrile reactions produced by diathermy in the treatment of chorea. In referring to this disease, I merely mentioned the results obtained by others with the use of vaccines.

The radiotherm, which was mentioned by Dr. Piersall, has been in use since 1929. With this apparatus, the patient is placed between two large condensers, thus eliminating the necessity of applying electrodes to his body. However, it is necessary to pass hot air over the patient's body in order to dry off the perspiration as fast as it forms. It has occurred to me that this hot air has a great deal to do with the elevation of the temperature of the patient.

No doubt such points are being worked out by the men using these machines. In the near future, reports from these, and other experimenters with the different methods of producing a therapeutic fever, will enable us to choose the most simple and safe method.

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# A STUDY OF THE CHANGES IN DEFINITION OCCURRING WITH THE BUCKY DIAPHRAGM OF THE MOBILE TYPE*

## A NEW DEVICE FOR CORRECTING THE CHIEF DEFECT RESULTING FROM ITS MOBILE CHARACTER

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THE Potter-Bucky diaphragm has found an increasing use due to its remarkable efficiency in eradicating scattered radiation over a large area of roentgenographic film. The writers can do no better than to call attention to the detailed, accurate analysis of the physical principles underlying this diaphragm by Wilsey (1922) (1). Briefly, these may be summarized as follows: Since the quality of the scattered radiation differs but little from the primary, the only effective method lies in its reduction by diaphragms, either by preventing its formation by limiting the volume of material irradiated, as in the case of a cone, or by screening it from the film after its formation by means of a diaphragm of the Potter-Bucky type placed between the source of the scattered radiation and the film. Only the latter method permits the use of a large film. The efficiency of this diaphragm in removing scattered radiation has been found by Wilsey to be independent of the distance between the scattering material and the grid, and remains practically unaffected by the presence of the wood strips used in maintaining proper alignment of the lead grids. The ratio between the slit width and depth, on the other hand, was found to be of utmost importance. The greater the slit depth in proportion to its width, the more marked was its efficiency. To illustrate, the employment of a slit ratio of 0.2 (slit width equal to one-fifth of its depth) resulted in a reduction of the ratio of the diffuse to focal radiation from 4.9 (without the diaphragm) to 0.65 with the diaphragm. This degree of reduction results in an efficiency of 86 per cent. De-

*Accepted for publication July 5, 1932.

creasing the slit ratio further produces an additional increase in the efficiency of the diaphragm.

However, the slit depth can not be increased without producing impairment in definition, and therefore the present construction of a Potter-Bucky diaphragm is such as to represent a balance between two extremes, in which the slit ratio permits a radical elimination of the scattered radiation without a great sacrifice in definition. To test these effects on definition, Wilsey prepared a set of gold-plated screens with a mesh-variation ranging from 110 to 280 strands per inch. These were mounted in a row and used as a test object. The shadow of the finest mesh which could be resolved by the eye was determined after varying slit depth, slit width, the distance between the scattering material and film, and the distance of the test object above the slits. The distance between the object and the film was found to be of extreme importance; hence the necessity of reducing the distance between the cover of the diaphragm and the grid level, and the distance between the film and the grid.

Because bakelite, or any other known radiotranslucent substitute, is flexible and yields under the influence of superincumbent weight, it is common practice to allow generously for this in order to prevent friction between the cover and the grid during the grid stroke.

Many movable Bucky diaphragms have been prepared with mounting rails, and ample clearance must be allowed for a mobile unit of this kind. The writers have seen many in which the distance between the object and film was so great as to practically negate the beneficial effects of the Bucky. The sacrifice in definition becomes sufficient to equal or outweigh the advantages of contrast accruing from the reduction in scattered radiation.

We have long felt the need for a mobile Potter-Bucky unit, but we have been hesitant about constructing such a unit because of the difficulties arising in its construction in maintaining a short object-grid distance. Recently, we have been successful in solving this difficulty, and the efficiency of this Bucky as regards elimination of scattered radiation and preservation of definition is the same as that of the diaphragm without the mobile feature.

## DESCRIPTION OF THE MOBILE FEATURES OF THE POTTER-BUCKY DIAPHRAGM

The slit ratio of this diaphragm[1] was approximately 0.16 (slit depth of 0.95 cm. and slit width of 0.16 cm.). The thickness of each individual grid was approximately 0.01 centimeter. The bakelite cover was removed. Ball-bearing rollers[2] were mounted at the four corners of the Bucky. Two of these for the front side of the table have a concave bearing surface for operation along a steel rail, with a convex upper bearing surface. The other two rollers have a flat bearing surface to track along a flat rail running along the rear side of the table. These rails, which were machined in our shop, were prepared for mounting to a wooden table of the usual proportions for radiographic work (Fig. 1). They were mounted at such a level that, with the Bucky in place, there was approximately 0.9 cm. (3/8 in.) between the top surface of the Bucky (with the cover removed) and the under surface of the table top. The table top of wood was 5-ply veneer, with a thickness of approximately 0.8 centimeter. This type of top was selected because of its relative inflexibility and its low cost.

The sag which such a top is certain to show causes no disturbance in the movement of the grid during exposure because of the generous allowance for operating space be-

[1]This diaphragm, with its housing, was one obtained from the Liebel-Flarsheim Company.

[2]Also obtained from the Liebel-Flarsheim Company.

tween the underside of the table top and the grid diaphragm. To test this point, during the construction of the unit, a short, stocky man 5 feet 6 inches in height and weighing 220 pounds was placed in the center of the table—there was no friction at any point along the entire run of the Bucky. But the presence of this wide space between the table top and the grid increases the object-grid distance. This, Wilsey has clearly demonstrated, materially decreases the definition. We wished to sacrifice nothing in definition in securing mobility, and an elevating mechanism was devised which raised the Potter-Bucky diaphragm from the tracks the necessary distance, so that the table top actually rested firmly upon upper edges of the Bucky housing. By means of this arrangement the conditions became practically the same as when the stationary bakelite top diaphragm was used.

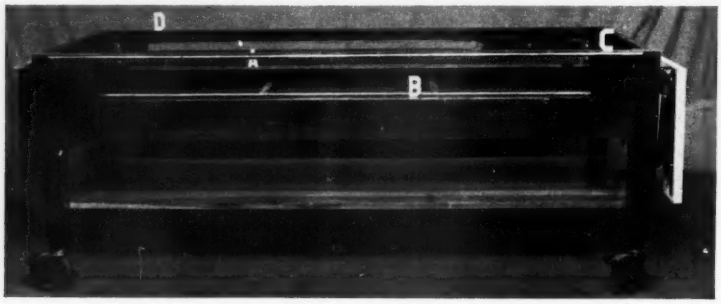


Fig. 1. Table with rails (*A* and *B*) serving as a track for the diaphragm. The top of the table and diaphragm have been removed. The steel bar (*C*), used to strengthen the table, is at the level of the grids when the diaphragm has been elevated into position.

The elevating device, consisting of a steel rod (1.3 cm. or 0.5 in. in diameter) with eccentric cams as illustrated in Figure 2, was mounted in the under surface of the center of the Bucky housing by means of a steel strip. These cams measured approximately 2.8 cm. (1⅛ in.) in the longer diameter, and 1.9 cm. (0.75 in.) in the shorter diameter. During the first part of the work the bearing surface of these cams operated directly against the rails and served to lift the entire diaphragm, with its rollers, from the track. During the movement of the diaphragm along the track these cams were so mounted as to be free of the track. Because of the tendency of the Bucky diaphragm to slide along the track when the thrust of the cam comes against the track during the act of elevating the diaphragm, shoes (Fig. 2) were devised with lower surfaces to conform with the bearing surface of the rails, and with a flat upper surface against which the cam acted. These shoes were fastened to the frame of the device by two steel pins on either side of the cam. A spring at the top of each pin held the shoes snugly down against the rail, preventing it from jumping the track when the diaphragm was moved. A lever handle was fastened to the near end of the steel rod, which turns the cam. The leverage is such that the amount of pressure required at the handle, to successfully accomplish complete elevation of the diaphragm, is slight. The appearance of the underside of the diaphragm, with the elevating device attached, is shown in Figure 3.

The film tray slides out immediately below the steel bar *C* in Figure 1. This bar

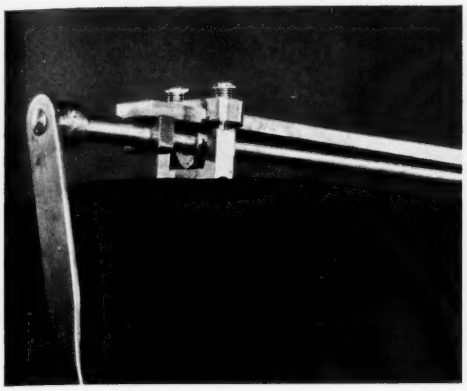

Fig. 2. Elevating mechanism with eccentric cam and shoe.

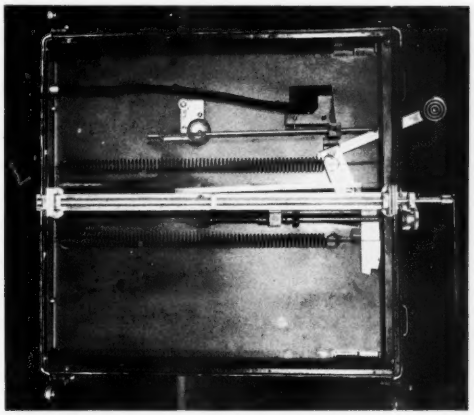

Fig. 3. Showing underside of the diaphragm with the elevating mechanism attached. The under surfaces of the two shoes are noted at either end of the diaphragm housing.

(approximately 1.3 cm., or ½ in. in thickness) is at the level of the grids when the diaphragm is in place, and is used in order to strengthen this side of the table without increasing the distance between the underside of the table and the grid level. The completely assembled table, with the Potter-Bucky diaphragm in place, is shown in Figure 4.

### DEFINITION TESTS WITH AND WITHOUT DEVICE

*Method.*—A preliminary set of films was obtained, using a set of wire mesh screens[3] as a test object, with the same diaphragm, under the following conditions: (1) Ordinary Potter-Bucky diaphragm with bakelite cover; (2) mobile diaphragm without the elevating device, substituting the wood table top for the bakelite cover; (3) the same diaphragm under the same conditions, employing the elevating device. The height of the test object above the bakelite top of the diaphragm or the table top was varied as follows: 0.0, 2.5, and 5.0 centimeters. Films were obtained both with and without fluorescent screens. The same Coolidge tube of the radiator type with a round focal spot of 33 sq. mm. was used in all tests. The type and amount of scattered material (12.7 cm., or 5 in., of water) was constant throughout all the experimental tests. The wire mesh screens were numbered from 1 to 17, beginning with the coarsest. Direct exposure films of the test object without the diaphragm were likewise secured.

The results are indicated in Table I. It will be noted that only the first five or six coarsest screens could be identified in the series without the fluorescent screens, and only the first three or four when fluorescent screens were employed. The grading of the wire screens was such as to prevent a finer analysis of the effects produced because of the type of grading at the coarse end of the series of screens. However, it is apparent that the films obtained on the mobile Bucky table, without the use of the elevating device, do not equal in definition the ones obtained with the same diaphragm when made stationary with the usual bakelite top. When screens are used, the definition is so seriously impaired that these finer

[3]We desire to express our indebtedness to Mr. Rex B. Wilsey for the use of his graded set of gold-plated, wire mesh screens, in making the preliminary tests of the diaphragm. His valuable suggestions concerning this work are likewise appreciated.

changes, due to changes in object-grid distance, are largely obscured by the effect of the screens.

Since the changes are difficult to study by means of this particular test object, a new test object was devised. Two fine wires (No. 32 B & S constantan) were approximated at one end of a bakelite strip (3.0 cm. × 16.0 cm.). The other ends of these wires were slightly separated. Their tension could be varied independently of one another at will by four adjusting screws (Fig. 5). The wire, composed of an alloy (constantan) of copper (60 per cent) and nickel (40 per cent) is radiopaque and can be identified even when a thick layer of scattering material is employed. An opaque centimeter scale is mounted along the course of the wires, with notches to indicate centimeters and millimeters.

The exposures were all made through 12.7 cm. (5 in.) of water, contained in a round aluminum vessel with thin walls. The test object was placed at the bottom of the vessel and 5 cm. above this level to determine the effect of increasing the object-grid distance. The distance between the underside of the Bucky cover and the top of the grid was varied as follows: 0.6, 0.9, 1.2, and 2.5 cm. (¼, ⅜, ½, and 1 in.). The exposure and developing technic were uniform throughout the series of films. A black mask with a small window was prepared, to aid in making the readings. To read results the slit window was placed over the open end of the wire shadow on the film, and

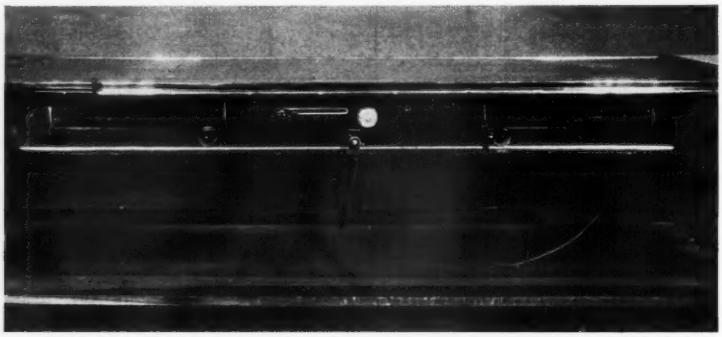

Fig. 4. Table with Potter-Bucky diaphragm in place beneath the table top of 5-ply veneer wood. By using the elevating mechanism, the distance between the object and the grids remains practically the same as that obtained when a fixed diaphragm is used with a bakelite cover.

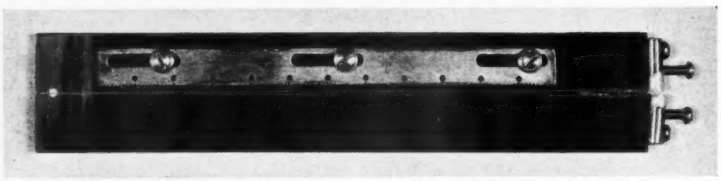

Fig. 5. Test object consisting of two wires converging at the lower end of the radiopaque scale. Their tension can be altered independently by adjusting the machine screws at the other end of the object. A collar placed about the open end of the wires permits varying degrees of separation of the wires to accommodate for any desired technic.

was moved toward the closed end until the black line between the wires could no longer be distinguished and the shadows of the two wires fused into one. This level is read by counting the centimeter and millimeter notches of the opaque brass scale.

## RESULTS

The readings of the scale are tabulated to illustrate the effect of increasing the distance between the object and grid while keeping the amount and type of scattering material constant. It will be observed that there is very little difference to be found whether wood or bakelite is used for the cover or top of the diaphragm, provided the distance remains the same. When the grid level is lowered in respect to the cover, changes in definition become obvious. Thus, increasing the distance only 0.6 cm. (¼ of an inch) causes a marked loss in definition. This is a small amount to allow for mobile diaphragm

TABLE I

Effect on definition produced by converting a diaphragm of the fixed type to one of the mobile type (with and without elevating device).

The figures in the body of the table indicate the finest mesh screen, the pattern of which can be resolved by the eye (the screens being numbered from the coarse end of the series).

| | Without Fluorescent Screens | | | With Fluorescent Screens | | |
|---|---|---|---|---|---|---|
| Distance of Test Object above Bottom of Water Phantom (cm.) | Bakelite Top | Wood Top without Elevation | Wood Top with Elevation | Bakelite Top | Wood Top without Elevation | Wood Top with Elevation |
| 0.0 | 6 | 5 | 6 | 4 | 4 | 4 |
| 2.5 | 6* | 5* | 6* | 4 | 3 | 4 |
| 5.0 | 5 | 4 | 5* | 4 | 4 | 4 |

*Pattern made out poorly.

TABLE II

Changes in definition produced by altering the distance between the diaphragm cover and the grid level.

The figures in the body of the table represent the readings of the opaque scale of the improvised test object.

| Distance of Test Object above Bottom of Water Phantom (cm.) | Usual Bakelite Cover | Wood Top ¼ in. 0.6 cm. | Wood Top ⅜ in. 0.9 cm. | Wood Top ½ in. 1.2 cm. | Wood Top 1 in. 2.5 cm. | Wood Top Using Elevating Device |
|---|---|---|---|---|---|---|
| 0 | 1.4 | 3.9 | 4.6 | 5.8 | 8.0 | 1.5 |
| 5* | 1.5 | 2.1 | 2.9 | 3.4 | 4.0 | 1.6 |
| Object-grid (top)[4] Distance (cm.) | 1.3 | 1.95 | 2.25 | 2.6 | 3.84 | 1.5 |
| Object-film[4] Distance (cm.) | 3.0 | 3.65 | 3.95 | 4.3 | 5.54 | 3.2 |

*The angle between the wires was increased for this test in order to obtain readable results at this increased object-grid distance.

[4]Distances given in the lower rows were obtained with the object at the bottom of the water phantom. Add 5 cm. to each to obtain distances when the object is elevated in the phantom.

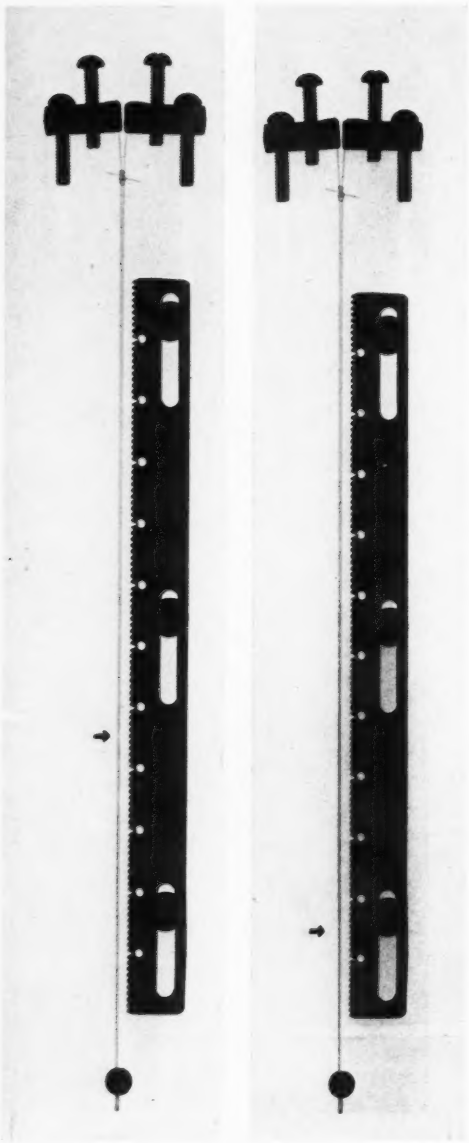

Fig. 6. Radiographs of test object with scale. The one on the left represents the result obtained when ⅜ inch was allowed between the underside of the cover of the diaphragm and the level of the housing of the diaphragm. An arrow has been placed at the point (4.6) at which the reading was made (point when shadows of the two wires fused). When this distance of ⅜ inch was eliminated by elevating the diaphragm against the underside of the table top, a reading of 1.5 (note arrow level of right radiograph) was possible. In other words, by elevating the diaphragm, the shadows of the two individual wires could be resolved by the eye as separate wires 3.1 cm. farther along their course.

due to the sag in the table top under heavy weight. It will be noted that, while the bakelite in close contact with the diaphragm housing, a reading of 1.4 is obtained, but when the distance is increased 0.6 cm. (¼ of an inch), the reading on the scale jumps to 3.9. At 0.9 cm. (⅜ of an inch) a further decrease in definition becomes obvious with a reading of 4.6 (Fig. 6). This is approximately the distance between the table top and the diaphragm in our table when the elevating device is not used. It becomes imperative, therefore, to eliminate the space between the underside of the table and the top margins of the diaphragm housing. This is best done by elevating the diaphragm against the underside of the table. This, in fact, not only eliminates the space between the table top and the housing, but actually gets rid of the sag produced by superincumbent weight. A reading of the scale, obtained after the use of the elevating device, is practically the same that is found when the usual bakelite cover is used (Fig. 6). The slight difference observed is probably due to the fact that the wooden table top is 1.5 mm. thicker than the bakelite cover. Had we obtained one of the same thickness as the bakelite, identical results would probably have resulted.

Another series of films were obtained under similar circumstances, except for the position of the test object, which was elevated 5 cm. in the water phantom. This change has a marked effect on definition, and the separation of the wires was increased at the "open end" in order to permit satisfactory reading of the scale. The same type of result was obtained. Increasing the distance between the table top and the diaphragm had a deleterious effect on definition. This could be eliminated by the use of the elevating device.

For convenience, the distances between the table top and grid, the object and grid, and the object and film, are listed in Table II.

The target-film distance was kept constant at 76 centimeters (30 inches).

## SUMMARY AND CONCLUSIONS

The harmful effects of increasing the object-grid distance on definition have been demonstrated by means of several different test objects. These results would indicate that the increased space between the object and grid, allowed for a mobile Potter-Bucky diaphragm, produces a very definite and considerable effect on definition. These deleterious effects can be avoided through the use of a simple elevating mechanism. The employment of this device, in connection with the diaphragm without the cover, permits results which are practically identical with those obtained with the usual "fixed" diaphragm with a bakelite cover.

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# THE ROENTGENOLOGIC DIFFERENTIATION OF LESIONS OF THE RIGHT AND LEFT HEART[1]

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IN the development of the roentgen examination of the heart, the accurate determination of the size of the organ has been chiefly considered. The differentiation of the normal from the abnormal heart by the increase in transverse diameter, surface area, or volume, as demonstrated in the teleoroentgenogram, or orthodiagram, has been well established.

Much less attention has been given to the increases in size, which may take place in individual chambers. While changes in the shape of the heart shadow have been widely used to determine the exact nature of the defect which is present, these have been chiefly studied in the postero-anterior projection. Lateral views which might demonstrate enlargement of the posterior chambers of the heart, the left atrium, and left ventricle, have been less emphasized, chiefly, no doubt, because of the difficulty in interpretation.

Cardiac disease, with or without failure, may, for certain purposes, be classified in two broad groups: left heart lesions and right heart lesions. The former are by far the more numerous and include essentially the defects of the valves of the left heart, the aortic and mitral, and the cardiac enlargements which result from increased blood pressure. With a few rare exceptions, the diseases of the left heart are acquired lesions. It is true that mitral valvular disease affects the right heart early in its career, but the lesion originates on the left side and is properly classified as such. Right heart lesions are less common and more heterogeneous. They include disease of the pulmonic and tricuspid valves, either congenital or acquired, other congenital defects, and right heart enlargements from diseases of the lungs or of the pulmonary vessels. Such pulmonary conditions as pneumonoconiosis, asthma, emphysema, and chronic lung fibrosis may produce sufficient obstruction in the pulmonary circulation to cause hypertrophy and dilatation of the right ventricle and right auricle, with eventual right heart failure. Likewise, primary disease of the pulmonary vessels, sclerosis, and, possibly, hypertension may eventuate in the same situation. It is a common feature of all these

[1]Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

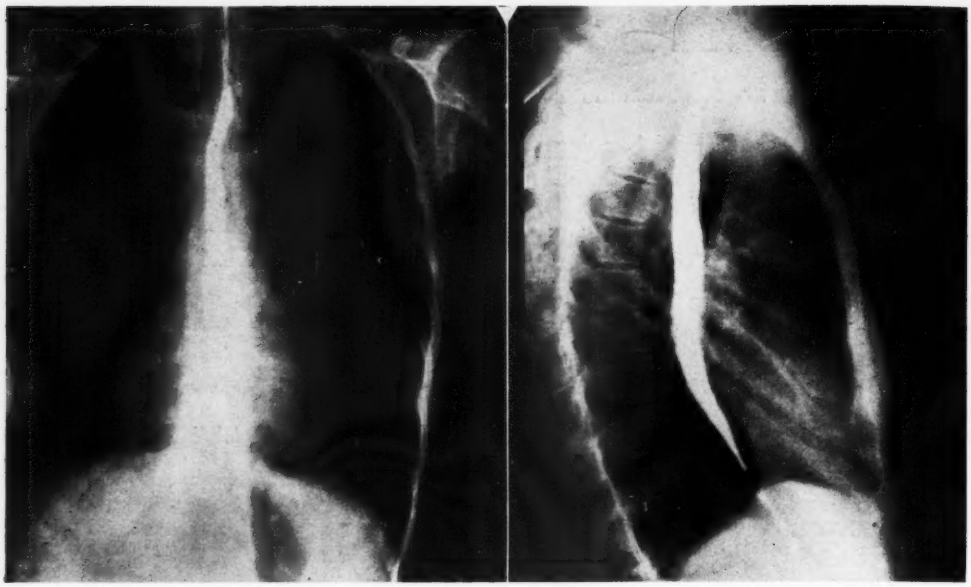

Fig. 1-*A (left)*. Postero-anterior teleoroentgenogram in a proved case of mitral stenosis. Note the very small "drop" heart with no evidence whatever of any abnormality.

Fig. 1-*B (right)*. The same case, lateral view. There is a distinct, although slight, displacement of the esophagus in the region of the left atrium, indicating some enlargement of this chamber and suggesting a diagnosis of mitral disease, in spite of the negative postero-anterior view.

diseases that the enlargement is confined to the right side of the heart, the left being rarely, if ever, affected, even late in the disease.

Ordinarily, the distinction between those lesions which primarily affect the left ventricle, such as aortic valvular disease and hypertension, and diseases of the right heart is comparatively simple, both clinically and roentgenologically. The physical findings and the postero-anterior roentgenograms are very different in the two cases.

In mitral disease, however, this differentiation is often difficult. That this is true can be borne out by anyone who has examined many cases of cardiac disease in children, in whom congenital defects are so common. The recent paper of Seham, Shapiro, and Hilbert (7) gives abundant evidence of this difficulty, especially in the early stages of the disease. A report of some cases by the author (3) presents a good picture of the difference of opinion which may occur amongst cardiologists when problems of this type come up. It is not surprising that this should be so. In many cases murmurs are atypical, the percussion dullness in the two types of heart may be much the same, and the history may be misleading.

Roentgenologically also, the distinction is often difficult to make. Particularly in children is this true because the enlargement of the right ventricle, which occurs in mitral stenosis, may simulate closely the appearance of a congenital cardiac defect. While in the majority of right heart lesions the postero-anterior roentgenogram may show striking differences from that of mitral stenosis, in many cases this difference is not reliable. Both groups of cases produce enlargement of the right ventricle and dilatation of the conus arteriosus and of the pulmonary artery. Usually, in congenital defects the latter is a more prominent feature

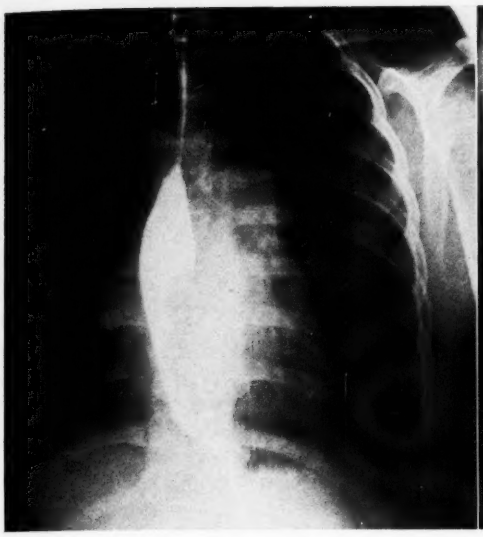

Fig. 2-*A (left)*. Postero-anterior roentgenogram in a case of double mitral valvular disease in a child. The shape of the heart strongly resembles that found with congenital defects, such as patency of the ductus arteriosus. Note the compression and displacement of the esophagus to the right, which frequently occurs in mitral disease.

Fig. 2-*B (right)*. The same case, lateral view. Note the marked posterior displacement and compression of the esophagus in the region of the left atrium. The retro-esophageal space is obliterated from the seventh to the ninth thoracic vertebræ. The appearance is typical of mitral valvular disease with enlargement of the left atrium. This diagnosis was made in spite of the postero-anterior appearance.

and the absence of the curve of the appendage of the left atrium may help to rule out mitral disease, but this also is of value only in the late stages.

From the standpoint of the pathologic physiology of the heart, one of the most essential differences between these two groups of cases lies in the presence or absence of enlargement of the left atrium. It is always enlarged in mitral disease with symptoms of cardiac embarrassment; in right heart lesions it is never enlarged. This difference is inherent in the very nature of the lesions which are present. The first effect of mitral stenosis upon the heart is left atrial hypertrophy and dilatation. In the case of mitral insufficiency, the left ventricle may possibly be affected first to a slight degree, but the left atrium follows shortly. If the teleoroentgenogram evidences a definite enlargement of the heart due to mitral disease, the left atrium must then also be enlarged. If the patient is presenting any symptoms of cardiac failure—no matter how slight—due to mitral disease, enlargement of the left atrium must already have taken place. In the right heart lesions, the whole process takes place on the other side of the pulmonary circulation and the left atrium is usually undisturbed.

The demonstration of an enlarged left atrium in this differentiation is, therefore, of considerable importance. There is another group in which it is of great value: those individuals without organic heart disease who have symptoms which simulate cardiac failure, who often have a systolic murmur at the apex, and in whom in some cases, the teleoroentgenogram suggests the appearance of a mitral heart. Usually the size is well within normal limits, but the contour may resemble that of mitral stenosis. With the knowledge that mitral stenosis often does not produce marked cardiac en-

Fig. 3-*A (left)*. Postero-anterior roentgenogram in a case of right heart enlargement of undetermined origin. There were no clinical signs whatever of valvular heart disease. There is absence of any esophageal displacement. This is the typical normal appearance. Note the resemblance of this heart to the one shown in Figure 1-*A*.

Fig. 3-*B (right)*. Same case, lateral view. There is no displacement of the esophagus, indicating that the enlargement is essentially of the right heart. Note the difference in appearance from the case shown in Figure 1-*B*.

largement, that diagnosis is often made. The situation described above may occur in the presence of a perfectly normal heart, as has often been demonstrated in the past. Many a normal individual, who is eventually proven to have no heart disease, has been refused life insurance and been greatly restricted in his activities because he happened to have such a combination of symptoms and signs. Every roentgenologist is familiar with these cases in which one sees a very marked convexity of the left median curve without enlargement of the transverse diameter or the surface area of the heart.

In this group, too, the determination of whether or not the left atrium is enlarged is of vital importance. The absence of demonstrable enlargement, while it would not rule out mitral disease, would indicate definitely that the apparent symptoms of cardiac embarrassment could not be due to myocardial failure of mitral origin. On the other hand, if the left auricle is shown to be enlarged, the diagnosis of mitral disease is definitely clinched.

Lateral examination of the thorax with the roentgenoscope or by the roentgenogram may demonstrate enlargement of the left atrium, but the results are difficult to interpret. The left atrium may be simulated by many structures which lie lateral to it and the vague shadow obtained is frequently not convincing. The utilization of the barium-filled esophagus for this purpose as de-

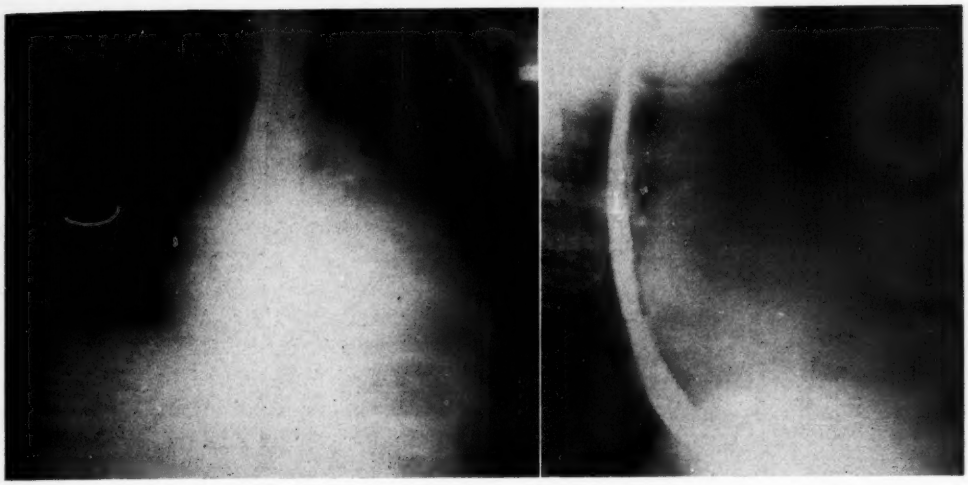

Fig. 4-*A (left)*. Postero-anterior teleoroentgenogram in a massively enlarged heart of congenital origin.

Fig. 4-*B (right)*. Same case, lateral view. There is little or no displacement of the esophagus, indicating that the enlargement shown in Figure 4-*A* is entirely right-sided. Such a large heart, if it were of mitral origin, would produce an extreme posterior displacement of the esophagus.

scribed by the author (4) and many others (1, 2, 5, 6, 8) is an effective and comparatively accurate method. The close relationship of the esophagus to the left atrium (which, considering its actual position, would better be called the posterior atrium) is well shown in the lateral view. Compression and displacement of the esophagus posteriorly and to the right occurs at an early stage in the enlargement of this chamber. If the proper technic is used, this displacement, in most cases, is readily seen, and is simulated only by a few, easily demonstrable conditions. In our experience, and in that of others (7) this method has been highly successful, both in the distinction of right and left heart lesions and in the separation of functional from organic cardiac disorders. The author has reported three striking cases illustrating the increased accuracy in cardiac diagnosis which is obtained in this way (3). Many other cases of a similar nature have since been observed.

The detailed technic of the examination and the normal and pathologic findings have been previously reported (4). The normal appearance of the esophagus after the ingestion of several ounces of very thick barium sulphate paste is seen in Figures 3-*A* and 3-*B*. The postero-anterior view (Fig. 3-*A*) presents a straight tube indented slightly by the aortic arch and curving to the left at the diaphragm. The right lateral view (Fig. 3-*B*), made during deep inspiration, presents a slightly curved tube, the convexity being posterior and the inferior portion curving anteriorly at the diaphragm. This view is made with the patient in the true lateral position, the right side being against the film. There is a definite distance of as much as 2 centimeters between the spine and the esophagus. In functional cardiac conditions, the esophageal findings may be much the same, although the postero-anterior view often resembles the configuration of mitral disease. In certain mi'd grades of mitral stenosis, the postero-anterior view may not be entirely characteristic, as illustrated by the case shown in Figure 1-*A*, and there may be no enlargement whatever of the transverse diameter of the heart.

From this film alone the diagnosis of cardiac disease could hardly be made. The right lateral view of the esophagus (Fig. 1-*B*) may, however, demonstrate clearly a slight posterior displacement in the region of the left auricle, helping greatly to confirm the clinical diagnosis of mitral disease. In the more advanced cases of cardiac enlargement from mitral disease, the compression and displacement of the esophagus are much more obvious, definite displacement to the right being shown in the postero-anterior view (Fig. 2-*A*) and toward the spine, in the lateral view (Fig. 2-*B*).

Occasionally, true cases of mitral disease, in children particularly, may simulate the appearance of a congenital defect in the postero-anterior view. This is well illustrated in Figure 2-*A*, from a well established case of mitral stenosis and regurgitation. The high position of the convexity on the left is strongly suggestive of a congenitally defective heart. Nevertheless, definite displacement of the esophagus to the right and posteriorly (Fig. 2-*B*) is well shown, establishing the presence of a dilated left atrium, hence the diagnosis of mitral disease.

Diseases of the pulmonary circulation, whether due to sclerosis, possible hypertension, or changes in the lung parenchyma itself, may give the appearance illustrated in Figures 3-*A* and 3-*B*. The first clinical diagnosis in this case was mitral stenosis and regurgitation. The postero-anterior view (Fig. 3-*A*) resembles either the cardiac configuration resulting from mitral disease or from a congenital defect. It could be considered as a fairly good example of the former, resembling quite closely the appearance shown in Figure 2-*A*. However, in the right lateral view (Fig. 3-*B*), there is no displacement whatever of the esophagus indicating that the lesion must be affecting the right heart exclusively, and, therefore, could not be due to mitral disease. Eventually, this case was shown to be of pulmonary origin with no valvular lesion whatever, the disease being confined to the pulmonary circulation.

Congenital defects may give much the same findings as illustrated in Figures 3-*A* and 3-*B*. Occasionally, combined congenital defects produce a very marked cardiac enlargement such as is shown in Figure 4-*A*. This would be very difficult to interpret by itself as the appearance might easily be produced by combined lesions of both the mitral and aortic valves. The absence of displacement of the esophagus in the lateral view (Fig. 4-*B*) effectively demonstrates that there is no enlargement of the left atrium. In the presence of such a large heart, mitral disease would thus be definitely ruled out; aortic disease alone could hardly be considered with such a postero-anterior configuration; hence a right heart lesion, probably congenital in origin, would be the logical diagnosis and this is clearly borne out by the clinical findings.

There are, obviously, certain inherent errors in the use of this method. In cases of marked kyphosis of the thoracic spine, for example, the space between the esophagus and the spine may be still present, even though the esophagus has been posteriorly displaced by an enlarged left atrium, the kyphosis compensating for the displacement. The contrary is true in lordosis of the thoracic spine, in which this space may be obliterated even in the presence of a normal heart. A lengthened, ectatic, descending aorta may retract the esophagus posteriorly, itself giving the appearance of displacement by an enlarged heart. In such a case, the lack of a dense shadow anterior to the esophagus, and the displacement of the esophagus to the left in the postero-anterior view, instead of to the right as is usual in mitral disease, helps to rule out this displacement. Occasionally, a displacement is seen in diffuse cardiac dilatations, such as occur with pericarditis, the toxic or fibrotic myocardium, and in the late stages of hypertension or aortic valvular disease. In these

cases, however, while the distinction from mitral disease may be somewhat difficult, there is usually no doubt that the heart is not normal and that it is not a right heart lesion. A complete absence of displacement of the esophagus may occur in mitral disease, but only when there are no cardiac symptoms. The physical findings which identify the condition in such cases are obtained accidentally, or during the course of a routine examination. Such a lesion is usually of little or no clinical significance.

In spite of these inexactitudes, intelligent application of this technic and intelligent interpretation of the roentgenoscopic and roentgenographic findings will prove to be an invaluable aid in the accurate differentiation of functional heart conditions and right heart lesions from the cardiac enlargement originating in disease of the mitral valve.

## SUMMARY

1. The clinical differentiation of lesions exclusively causing enlargement of the right heart from mitral valvular disease is often most difficult. The postero-anterior roentgenograms may be of little value in some cases.

2. Certain functional cardiac conditions may simulate mitral valvular disease clinically. In these, the postero-anterior roentgenogram may resemble that seen in mitral disease.

3. The examination of the barium-filled esophagus may be a great aid in this distinction. Very early in the course of cardiac enlargement of mitral origin, posterior and often right-sided displacement of the esophagus occurs, due to the enlargement of the left atrium.

4. This displacement does not occur in the other two types of cases, because either there is no cardiac enlargement at all, or else the right side alone is affected, the left atrium remaining normal.

5. This method of distinction has been used in many difficult cases with striking success.

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## DISCUSSION

Dr. Fred J. Hodges (Ann Arbor, Michigan): Dr. Rigler has emphasized the importance of examining the heart itself by a similar routine procedure, giving proper weight to recognizable changes in the size, shape, and position of various portions of the cardiac shadow as seen in various views. He has shown, furthermore, that, as a result of thoroughgoing study, information can be gained which compares favorably in value with information obtained by ordinary methods of physical examination, and that the roentgenologist is fully justified in drawing clinical conclusions from his observations.

We have all heard cardiologists question the roentgenologist's right to diagnose roentgenographically a valvular lesion. Many clinicians feel that roentgenology has contributed but little to cardiac diagnosis. I feel that we have been shown that the roentgenologist can, in many cases, offer valuable clinical information based upon variations in appearance, which in turn have a sound physiologic basis. We have seen that many of these observations are fully as reliable as the recognition of a typical cardiac murmur. As a group, we roentgenologists have long been content to make somewhat offhand comments concerning the probability of cardiac or vascular damage, without making a serious or detailed study of the heart and great vessels. If we were to accord to this field the

same careful attention to routine and detail which has come to be accepted for roentgen examination of the urinary tract, the paranasal sinuses, and the chest, I feel sure that the value of the roentgen findings in cardiovascular disease would be more widely accepted by cardiologists. Careful fluoroscopic study of the chest, including orthodiagraphic plotting of the cardiac silhouette, examination in various oblique views, observations of the contour and course of the esophagus when it is filled with barium, together with film studies as indicated by fluoroscopic appearance, should be the routine employed by the roentgenologist in every case in which cardiovascular disease is suspected.

Dr. L. R. Sante (St. Louis, Mo.): Dr. Rigler's paper is an example of the application of practical observation in radiology. Analysis of the situation, not only in this but in other fields, might aid us a great deal in understanding our observations. The findings Dr. Rigler has demonstrated are really what you would expect, and the changes he has shown are really the changes that you would expect to see, but he has shown them in a very graphic way.

In a rather recent development of synchronization of roentgenograms with the heart beat by means of an electrocardiograph, setting off the x-ray apparatus in extreme systole and diastole of the heart, an instantaneous record of the cardiac outline during the extremes of contraction and relaxation is obtained.

This seems to me to be of great fundamental value. For instance, by the calculation of the heart volume for extreme systole and extreme diastole, the output per beat can be calculated, which is, after all, the basis for determining cardiac function.

Knowing the output per beat, the way is opened for determining what effect certain drugs have upon the heart and circulation. It seems to me that such investigation would be of fundamental importance. It is by no means a simple procedure; it requires special apparatus and special painstaking methods. It is not yet ready for the general radiologic department.

Dr. Drew Luten (St. Louis, Mo.): An intensive study of any diagnostic procedure, such as Dr. Rigler has given to the problem that he presented so clearly, has a twofold value. It improves the technic of the test and makes it more valuable in differential diagnosis. Sometimes, more important still, it leads to a better understanding of the disease process under investigation. The conception, to which Dr. Rigler refers several times, of enlargement of the left auricle with heart failure would appear to give important support to the notion that ventricular failure is associated essentially with inability of the ventricle to deliver the blood that is supplied to it.

There is still some discussion as to ventricular output in heart failure. Dr. Rigler's observation would appear to support the conception that there is a relative, if not an absolute, diminution ot output and an inability to deliver the blood that is supplied from above.

The same underlying factor would appear to be associated with right ventricular failure, even though the disease process responsible for that failure depends ultimately upon different causes. I was rather interested to note that Dr. Rigler included among those lesions which cause right heart disease such processes as bronchial asthma and emphysema. It is Kountz and Alexander's belief that bronchial asthma and emphysema do not produce right heart disease, their ideas being supported both by theoretic considerations and by postmortem findings.

In a clinical study of the hearts of asthmatic patients, we found no increased incidence of heart disease. The finding of right axis deviation in the electro-cardiogram, which has been reported in support of right heart disease in such cases, can hardly be interpreted as an evidence of right heart disease, because the electrical axis commonly deviates to the right in that position of the heart assumed with the associated emphysema.

The question of whether or not bronchial asthma and emphysema are important causes of right heart disease, however, is not an integral part of Dr. Rigler's paper. If I may,

for just a moment, I will refer to the remarks of your chairman that roentgenographic observations of the heart are equal in importance to clinical observations, a conception which cannot be controverted. Certainly the radiologist should have only thanks for the knowledge he gives. The work Dr. Rigler has done must indeed, in many instances, be of very great help in differential diagnosis.

Dr. Samuel Brown (Cincinnati, Ohio): The determination of the correct size of the heart for the particular individual under examination has always been a difficult problem for me to decide. The several factors given by the speakers, upon which the determination of the correct size of the heart is made, are, in my opinion, too variable under normal conditions to depend upon, and they may lead one to incorrect conclusions.

In my work I have found that there exists one factor which is constant under normal conditions: the constancy of the relationship between the heart and aorta and the thoracic cage. When the heart is enlarged, or the thoracic aorta is dilated, the relationship is immediately disturbed. This disturbance in relationship is easy to recognize both in the anterior and the lateral views of the thorax.

Dr. Rigler (closing): I just want to correct a false impression which I gave. I did not mean to associate the left atrium as a causative or etiologic factor with heart failure. I have not the temerity to rush in and discuss whether the atrium or the ventricle is associated with failure. I meant only to point out that, in the stage of cardiac disease which we have when failure occurs, there must already be an enlargement of the left atrium. I did not mean to say that it is an important part of failure. I have no opinion on that question.

Likewise, I have no opinion on the question of asthma as a cause of right heart disease. I merely mentioned it because it is a common conception. I certainly do have an opinion that chronic lung disease with marked fibrous change will create heart enlargement. There are many pathologists who thoroughly believe that emphysema and asthma are related to right heart failure.

Dr. Hodges (closing): To correct any misapprehension on Dr. Luten's part concerning present relationships between roentgenologists and cardiologists, I wish to assure him that I feel any criticism we may have received in the past has been entirely justified. Haphazard roentgen examination of the heart and great vessels has led to a lack of confidence on the part of clinicians in such studies. This state of affairs can and should be corrected.

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# IODIZED RAPESEED OIL (CAMPIODOL), AN IMPROVED ROENTGENOGRAPHIC OPAQUE OIL[1]

By MARK ALBERT GLASER, M.D., Los Angeles, and
GEORGE W. RAIZISS, Ph.D., Philadelphia

FOLLOWING the experimental introduction of campiodol (Frazier and Glaser, 1; Glaser, 2), it immediately became apparent that an iodized oil most efficient for the visualization of the various body cavities should have physical properties adaptable for each individual cavity. This led to the synthesis of dilution products as well as an emulsion.

Undiluted campiodol is best used to outline the tracheobronchial tree. The dilution of campiodol with ethyl olive oil resulted in a free-flowing, less viscous compound, which still retained sufficient opacity

[1]Read before the Radiological Society of North America, at the Sixteenth Annual Meeting, at Los Angeles, December 1-5, 1930.

for roentgenographic visualization. Equal parts of campiodol and ethyl olive oil were ideal for the visualization of the nasal sinuses; whereas a 4-to-1 dilution was invaluable for the outline of the subarachnoid space, the blood vessels, fistulæ, uterus, and salpinx. In order to visualize the genitourinary tract, an emulsion of campiodol proved the most satisfactory and has been utilized successfully in over 500 cases.

Fig. 1.

Fig. 2.

The ability of certain oils to absorb iodine depends on the unsaturated property of some of the carbon atoms composing the glyceryl esters present in the oils. These unsaturated glyceryl fatty esters vary in their degrees of iodine absorption, and those with the highest amount of unsaturation will naturally absorb the largest amount of iodine. The iodine will be held in firm union once it has combined with the free valence linkage of the carbon atom. The iodization of rapeseed oil was accomplished by utilizing a variation of the methods of Hubl wherein mercuric chloride is used as a catalyst. This method of iodization has been described elsewhere (Raiziss, Glaser, and Clemence, 3).[2]

Rapeseed oil (colsa oil), which proved to be the most satisfactory for iodization purposes, is derived from the seeds of *Brassica napus, Brassica campestris, Brassica rapa.* It is a yellow, almost odorless oil with a specific gravity of 0.914 and an iodine value of 93.5 to 105.6. It is composed of the glycerides of stearic, erucic, and an oleic acid.

Iodized rapeseed oil (campiodol) is a light yellowish, semi-viscous, transparent oil

[2]The author has included citations from the literature subsequent to the reading of his paper.

with a slightly aromatic odor and oleaginous taste. It contains from 43 to 45 per cent iodine and its specific gravity is from 1.2 to 1.3 at 20° centigrade. It is soluble in chloroform, ether, benzene, and carbon bisulphide, and insoluble in water and alcohol. This chemical compound deteriorates very slowly upon exposure to light and heat, some samples remaining stable for over a year, with which, upon radiographic exposure, an intense shadow is obtained.

Campiodol (rapeseed oil) is an oil of very low toxicity. Given by mouth, dogs have withstood 6.75 c.c. per kilogram of body weight without toxic effects. Injected into the internal carotid artery, with ligation of the external carotid, the dogs were able to withstand 1.5 c.c. per kilogram of body weight. Six c.c. of oil have been injected into the subarachnoid space by cisternal injection in dogs weighing from 4 to 5 kilograms, without toxic effects. Spinal-fluid-cell counts on dogs wherein 2 c.c. of iodized oil have been injected by cisternal puncture varied from 250 to 600 cells per c.c. between the first and second days. At the end of five or six days, the cell count ranged between 5 and 15 cells per cubic centimeter. In clinical cases of hydrocephalus 7 c.c. of the oil were injected into the ventricles with a maximum count of 310 cells per c.c. on the second day.

For use in the spinal subarachnoid space, 4-to-1 iodized rapeseed oil is an ideal product because of its free-flowing qualities and low viscosity. Campiodol may be injected through a small caliber needle either in the lumbar region or in the cisterna. By elevating or lowering the head of the patient, as well as placing him on his back or abdomen, its flow may be observed under the fluoroscope. In this manner partial or complete spinal block may be determined.

Iodized rapeseed oil should not be indiscriminately used and should not be used as a routine. Great care should be taken in the selection of the proper cases. Its use is particularly indicated in those cases wherein a level lesion is present upon clinical examination, and the jugular compression test demonstrates the absence of blocks, or in those cases wherein a level lesion is absent and the jugular compression test indicates presence of a partial or complete block. In suspected cases of tumor of the cauda equina, campiodol is of great value. An oil of a specific gravity lighter than the spinal fluid is undesirable in the demonstration of spinal block because violent reactions occur, such as high temperature, convulsions, and increased cell count (Figs. 1 and 2).

Fig. 3.

The cerebral vascular system has been outlined by the injection of the internal carotid, with ligation of the external carotid (Fig. 3). So far this has been used only in dogs. Moniz (4) with sodium bromide, and more recently Saito, Kamikawa, and Yanagizawa (5 and 6), with an emulsion of iodized oil, have successfully outlined the cerebral vascular system.

Rice (7), in a personal communication to the authors, has reported the use of campiodol in nine cases of peripheral vascular lesions. He prefers the 50 per cent mixture because it is of the same specific gravity as blood. In this manner he is certain about accurately determining the venous flow.

Fig. 4.

Ten c.c. of campiodol were injected into the blood stream without symptoms (Fig. 4).

Campiodol is also of value in demonstrating the patency of the vessels as well as accurately localizing the area of obstruction.

Iodized rapeseed oil is of great aid in the accurate diagnosis of chest pathology, particularly in those patients complaining of persistent cough, expectoration, hemoptysis, or chest pains in the absence of tubercle bacilli. It is contra-indicated only in those cases wherein the oil will lower the vital capacity below that of normal. Dr. William B. Faulkner, Jr. (8), has found that the catheter method of injection gives more consistent results. Campiodol is introduced under the fluoroscope so that its flow may be visualized through the bronchi, the x-ray plates being taken immediately. In those cases wherein a bronchus was occluded by pus, a foreign body, or tumor, preliminary bronchoscopy was necessary to clear the pathway.

For the diagnosis of bronchiectasis campiodol has been of extreme importance to demonstrate the extent and location of the process. Frequently cases of bronchiectasis can be diagnosed only by this method. In empyema, campiodol is of value to determine the degree of lung expansion, and in this manner further treatment may be prescribed, particularly in those cases of closed drainage. Chronic abscesses of the lung can readily be filled with campiodol. Acute lung abscesses can be visualized only if the obstructed bronchus is treated preliminarily by the bronchoscope. This clears the bronchus of pus, granulation tissue, or edema. In some cases of lung disease a definite therapeutic value has been noted.

Fifty per cent of campiodol and 50 per cent of ethyl olive oil has proved most satisfactory for outlining the maxillary sinus. Due to its diminished shadow-casting property, the essential soft tissues may be clearly outlined and because of its low viscosity special syringes are unnecessary. Iodized rapeseed oil has proved of great value in determining the exact thickness of the mucous membrane and in the diagnosis of polyps and cysts, also for the clearing up of antrums wherein the density was due to increased bone or unerupted teeth. By determining the exact thickness of the antrum wall a more exact prognosis can be offered the patient and the indication for medical or surgical treatment may be more accurately determined. The frontal sinuses may also be outlined.

To overcome the objections of many observers who have been unable to tell when the antrum is filled completely, thus frequently advising operation on antrums without thickened walls, a series of head positions have been devised so all the walls of the antrum may clearly be visualized, the shift of the oil in the sinus permitting such observations (Glaser, Futch, and Snure, 9).

In urography, emulsified iodized rapeseed oil has proved satisfactory (Glaser and

Kutzmann, 10). Emulsification has permitted the oil to mix with the urine in the kidney pelvis and because of this slight viscousness, reflux into the bladder has been prevented. By its use pain, burning, and other signs of discomfort have been eliminated because of the inertness of the product. Cystograms and urethrograms may also be obtained with much ease. The syringe method has been utilized in these cases because of the slight viscousness of the emulsion. Dr. A. A. Kutzmann (11) has used this product in over 500 cases without any toxic effects and with a maximum relief of symptoms.

Dr. M. J. Abramson has utilized this produce in a 4-to-1 dilution in uterosalpingography without any toxic effects and without pain. A 4-to-1 solution has proved of unusual value for the outline of the body sinuses.

For the outlining of sinuses, a 4-to-1 dilution is quite satisfactory and clear visualization is obtained.

### CONCLUSIONS

1. Iodized rapeseed oil, campiodol, because of its various products designed particularly for the different body cavities, is of great value for roentgenologic visualization.

2. It has been used in the subarachnoid space, cerebral ventricles, vascular system, nasal sinuses, the tracheobronchial tree, male and female genito-urinary tracts, and fistulæ without toxic effects and with an ease of administration and maximum of visualization.

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# CASE REPORTS AND NEW DEVICES

## AN INTERESTING CASE OF OSTEOCHONDROMA

By LESTER J. WILLIAMS, M.D., F.A.C.R.,
Baton Rouge, La.

In the past few years a marked advancement has been made in the diagnosis and treatment of bone tumors. The interesting and educational Bone Tumor Clinic of Dr. Bloodgood and Dr. Geschickter, as well as the appointment of a Registry Committee by the American College of Surgeons to study and classify bone tumors, have contributed in a large measure to a better understanding of the value of early diagnosis of bone tumors.

Many of the benign bone tumors are re-

garded as being incapable of producing harmful effects other than a slight discomfort and, at times, slight pain. For this reason these tumors are permitted to progress, without attention, until such serious complications arise as to demand immediate attention. It is a wise physician who makes frequent use of the roentgen ray in observing the progress of benign bone tumors for possible complications, such as malignancy, also their encroachment upon vital structures, and marked destruction of adjacent bones.

Osteochondroma, considered one of the benign tumors, on account of its usually mild symptoms and frequent occurrence, often evades clinical observation.

In presenting this case of osteochondroma, I appreciate that it is a manifestation of a not uncommon disease with which every roentgenologist is familiar. The case is interesting and instructive because it demonstrates that a so-called innocent benign tumor, such as an osteochondroma, is capable of producing serious results so insidiously as to be unobserved except by the roentgen ray.

Fig. 1

Case B. F. B., male, aged 19, weight 129 pounds, height 72 inches. Family history: Mother, 50 years of age, living and well; father died at the age of 55; cause of death, nephritis. No history of rickets or skeletal deformities in the family, nor was there any history of tuberculosis or cancer.

*Present Illness or Complaint.*—About five years previous to the present examination the patient noticed a swelling of the left ankle. He thought nothing of it until the summer of the fifth year when it became larger, causing a deformity above the external malleolus. He also noticed that the left knee was smaller than the right. There was no pain, and he was able to play tennis and exercise regularly without difficulty.

*X-ray Examination.*—An osteochondroma of the left tibia was seen, measuring approximately 3.5 by 4 cm. and located on the outer posterior surface about 5 cm. above the ankle joint. The left fibula near the site of the enchondroma of the tibia exhibited a deformity from pressure of the benign growth.

The most striking thing in the roentgenogram of this case is the appearance of erosion of the fibula, with only a thin cortex remaining as a result of continued pressure. Incidentally, the fibula is regarded as one of the strongest bones in the body. The pressure of the osteochondroma of the tibia against the fibula has caused a bowing outward of the latter bone, amounting to 2 centimeters. One would imagine that this bone, instead of gracefully retreating with the formation of this symmetrical arch, would have halted and diverted the tumor enemy army.

In his work on "Bone Formation," Jansen gives us some illuminating information about bony tissue which shows "a natural liability to absorption, a tendency to yield, with regard to lateral pressure of softer neighboring structures." He states as axiomatic that the vertebræ will stand 2 kg. pressure per sq. cm., in the direction of pressure for which the bone is built, but if the pressure is applied at right-angles, only one-eighth of this amount is necessary for rapid destruction of bony tissue.

## REDUCTION OF FRACTURES AND REMOVAL OF FOREIGN BODIES

### USING OIL-IMMERSED SHOCK-PROOF UNITS, BI-PLANE FLUOROSCOPY, AND SPECIAL FRACTURE DEVICE

By LEX G. McCUTCHEN, M.D., Department of Radiology, St. Louis University and St. Louis County Hospital

There is a growing demand for the separate fracture room in the x-ray department. That this room should be equipped with modern x-ray and fracture facilities goes without saying. In the writer's experience in x-ray and fracture work, he has found that the oil-immersed tube, the bi-plane fluoroscopic screen, and a simple mechanical means of extension should be available units of these facilities.

Since the introduction of the oil-immersed tube, it has been a relatively simple matter to have a fracture room that is free from the dangers of electrical shock—an advantage which can best be appreciated by those who have worked in the darkness of the old-time fluoroscopic room, with its hazardous overhead wires.

The safety of the oil-immersed tube has also been an advantage in bringing about the use of the bi-plane fluoroscopic screen, which has been found practical and exceedingly helpful both in fracture work and in the removal of foreign bodies. The lateral view afforded by the bi-plane is a great time-saver, as it serves as an *instant* check on the accuracy of the anteroposterior view. The two views of the bi-plane can now be conveniently controlled by two foot switches incorporated in a block, together with the light button (Fig. 2). Using this method of control, it is possible for the operator to shift instantly from the anteroposterior view to the lateral, and *vice versa*, or to turn on the light in the room without shifting his position. Radiographs may also be made in two views without moving the pa-

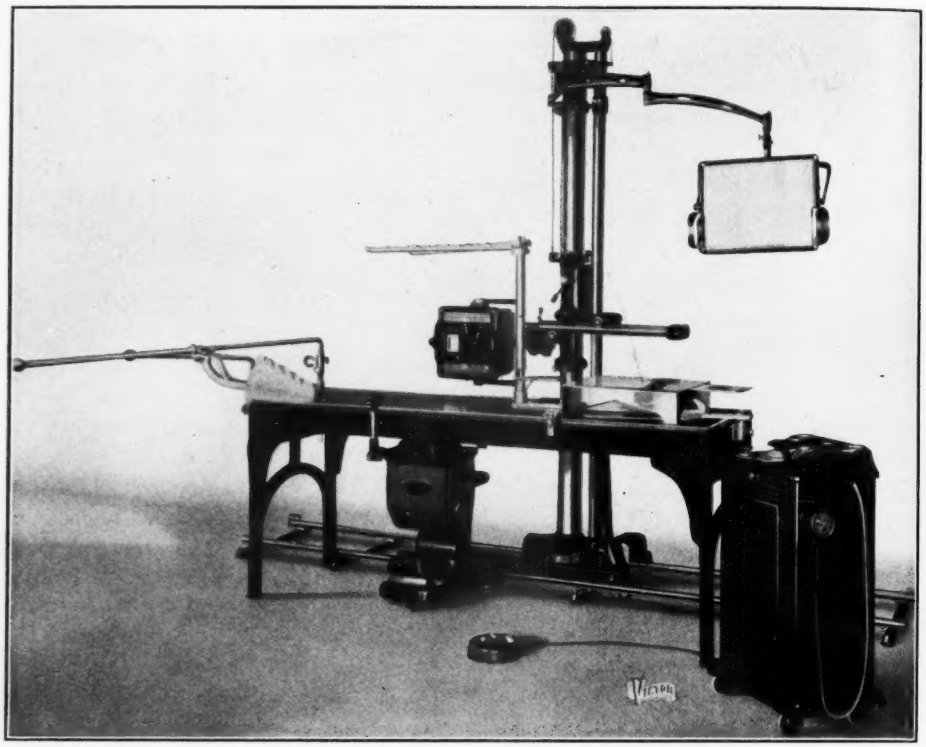

Fig. 1. Fracture device and shock-proof oil-immersed unit using single screen adjustable for anteroposterior and lateral views.

tient or changing the setting on the control stand. This combination switch has been in use for some time and it has proved very satisfactory.

The fracture apparatus illustrated was devised some years ago by the writer for use in conjunction with the fluoroscope. Since the first publication describing it, several improvements suggested by its use have been made, although the general structure of the apparatus has remained the same. Its efficiency has been greatly increased since the advent of the oil-immersed tube, as the reduction of fractures in the x-ray room prior to this was greatly hampered by the dangers of overhead wiring. It saves time, energy, and unnecessary handling of the patient, as the fracture may be reduced, the cast applied, and the radiograph made on the x-ray table. Another advantage lies in the fact that it is portable. It may be taken to the operating room to provide extension during open reduction and its attachment or detachment is extremely simple. When it is removed from the table, the fracture room, equipped with oil-immersed tube and biplane fluoroscope, becomes an ideal foreign body room.

In the reduction of fractures of the upper extremity, the patient is placed at right angles to the table, with the standard in the axilla or against the chest wall (Fig. 4). By using the long lever under the control of bi-plane fluoroscopy, the fragments of broken bone can be manipulated. After reduction, steady extension may be main-

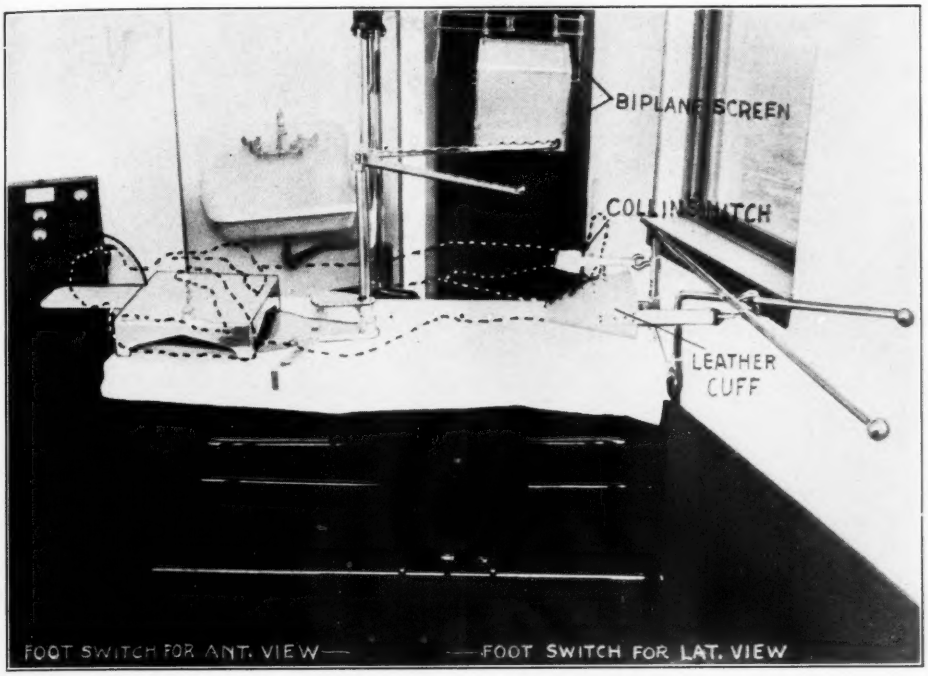


Fig. 2. Fracture device on x-ray table with bi-plane screen and shock-proof oil-immersed unit.

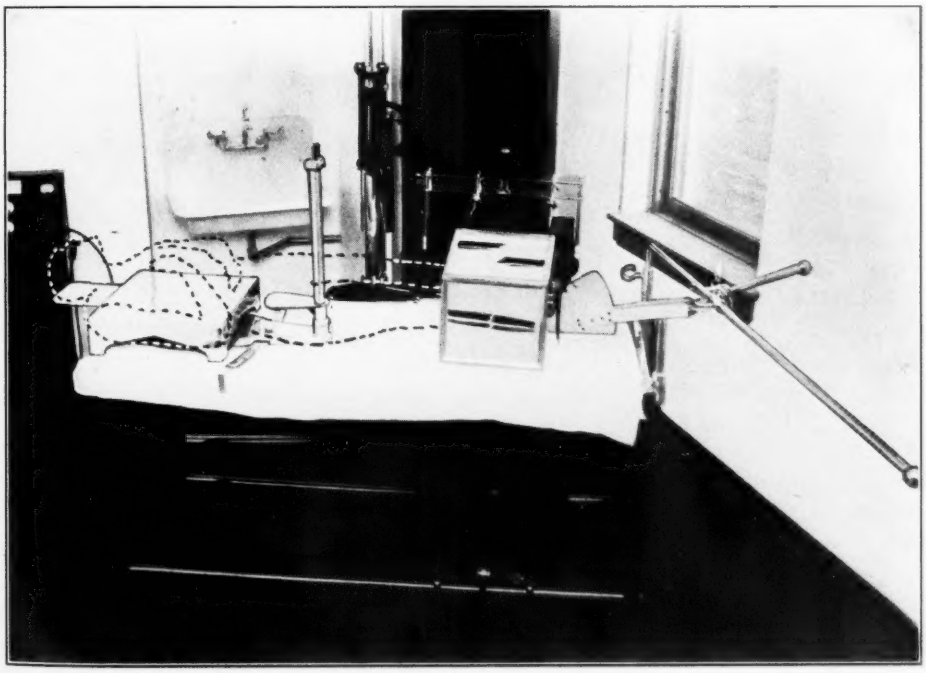

Fig. 3. Lower extremity fracture using fracture device, bi-plane screen, and shock-proof oil-immersed unit.

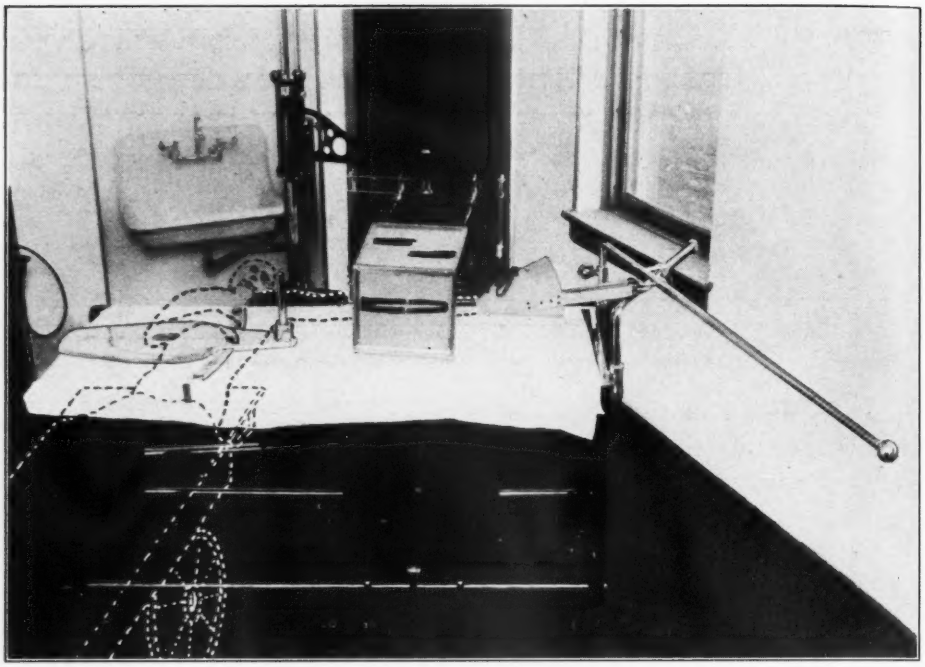

Fig. 4. Upper extremity fracture; traction at right-angle to body, with bi-plane fluoroscopic control and shock-proof oil-immersed unit.

tained and x-ray films made in two views without changing the position of the fractured extremity.

In the reduction of fractures of the surgical neck of the humerus, the leather cuff can be adjusted along the lever until the fragments are in good alignment when viewed under the fluoroscope. Adequate traction is available.

In the reduction of lower extremity fractures, the patient is anesthetized on the stretcher, then lifted to the table and placed on the pelvic support, back and head rest. The extremity is wrapped in sheet cotton or encased in stockinet. A Collins' hitch of three-inch muslin bandage is then tied to the ankle. The leather cuff is applied over the hitch (using three eyelets). After the necessary extension has been obtained, radiographs are made in two views without changing the position of the patient or the setting on the control stand of the x-ray machine.

Removal of the leather cuff without releasing extension is very simple. The ends of the Collins' hitch are tied to hook on the long traction bar. This maintains extension after the cuff is removed. The hitch may be incorporated in the cast or removed after the cast is applied.

The writer has found the combination described to be helpful and it is his belief that it will prove a valuable as well as an attractive addition to an x-ray department.

# EDITORIAL

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## A LIST OF POSSIBLE VARIABLES FOR RAY EFFECT INVESTIGATIONS

Scientists hold the most optimistic views concerning the possibilities which lie in the field of x-ray and related ray applications. This is true of workers in fields which are widely separated. H. J. Muller,[1] of the University of Texas, for instance, stated of his field, genetics, that x-rays are means by which we may be able to regulate life itself. His statement has to do with the kinds of modifications which we may make in genes and chromosomes. A. H. Compton is quoted as stating that if the voltage of x-ray tubes can be raised to between ten and twenty million, the door to the release of atomic energy may be opened.

It is the purpose of the following list to name the conditions which may be varied in either the tube, the ray, the surrounding spaces, or in the treated material itself during such fundamental investigations of ray effects. An attempt has been made to imagine all of the possible variables of possible significance, but no claim is made, of course, that it is complete. Nevertheless, it is believed that a great deal of the future sciences of genetics, ray chemistry, and ray physics, as well as future x-ray machine design, must be erected within the framework here indicated. At best, however, the aid will be merely such as the armchair philosopher can give the real investigator. The writer would be glad to hear of additions to the list which others may make, and suggests that some scientific librarian take the subject in hand to give the variables library index numbers in the same way that radio literature has been codified. An enormous ray effect literature already exists. The list, proceeding from the obvious variables to the obscure ones, is as follows:

Vary the identity of the material rayed.

Vary distance from ray source.

Vary time of treatment.

Vary number of treatments.

Vary voltage of tube, *i.e.*, hardness of ray.

Vary milliamperage of tube, *i.e.*, quantity of ray.

Vary target temperature.

Vary target material: *(a)* metals; *(b)* non-metals; *(c)* mixtures or compounds.

Vary filament temperature.

Vary filament area.

Vary filament material.

Feed tube alternating current: *(a)* vary wave shape.

Feed tube direct current: *(a)* vary current, as pulsating.

Control electron flow in tube with grid: *(a)* modulate ejected x-rays.

Control character of radiation by magnetic field (Faraday effect).

Control character of radiation by electrostatic field.

Control character of radiation by filter: *(a)* liquids; *(b)* solids; *(c)* solutions; *(d)* thickness; *(e)* angle.

Vary character of secondary radiation in subject by first injecting secondary x-ray generating material.

Vary character of x-rays by mixing with

[1] Heritable Variations: Their Production by X-rays and Their Relation to Evolution. Smithsonian Rep. for 1929, pp. 345–362; also Scientific Monthly, December, 1929.

other radiation, such as radium, ultra-violet, etc., of selected wave length.

Vary polarization of x-rays themselves.

Vary polarization of admixed ray.

Vary temperature at which treatment is given.

Vary pressure at which treatment is given.

Vary gases of atmosphere in which treatment is given.

Vary kind of cells to which treatment is given (by shielding selected portions).

Vary age of cells to which treatment is given.

Vary pH of cells to which treatment is given (acidity or alkalinity).

Vary humidity of atmosphere at which treatment is given.

Vary water content of cells to which treatment is given.

Vary work done by cells before treatment is given.

Vary work done by cells after treatment is given.

Vary food supply of cells before treatment is given.

Vary food supply of cells after treatment is given.

Vary number of sources of x-rays acting at one time.

Vary angles at which such sources act.

Vary amount of hormone stimulation of cells before, during, or after treatment.

Vary degree of dispersion of material before treatment.

Vary electrical grounding of material to which treatment is given.

Vary electrostatic charge of material to which treatment is given.

Vary current flowing through subject.

Vary direction of current flowing through subject.

Vary type of current flowing through subject.

Vary number of components of system being rayed.

Vary phases of components being rayed.

Vary phase incidence of rays from two or more sources in the material itself.

Use secondary radiation exclusively.

Use reflected radiation, as from crystal surfaces.

Vary magnetic influences on subject being rayed.

Vary order of raying of parts or components of subject.

Vary kind of mechanical stresses on subject being rayed.

Vary value of mechanical stresses on subject being rayed.

Vary the raying of food supply of subject.

It is plain that after varying the above factors one at a time, they may then be varied two at a time and so on. In this way compound effects may be produced. Since the number of combinations thus contemplated approximates infinity, a statement of the "alphabet" upon which they are based may be of value. While predictions are hazardous, it would seem as if important biological effects, at least those tending to advance the specialization of species, would not flow from the variation of a single factor.

As Baekeland said of our laboratory chemistry compared to that of life processes, it is like trying to play the piano by exploding a dynamite cartridge between the strings. Such a statement is equally true as to the biological effects of our present methods of raying.

To use a different figure of speech, the x-ray is capable of becoming a sculptor's tool in the hands of the biologist and geneticist. Hitherto, it has been only, in therapy, a means of destroying pathologically affected cells. Development would, therefore, seem to lie in the modification of its violence and in the modulation of its waves to a complexity of oscillation commensurate with the complexity of the results desired.

CHESTER TIETIG, M.S.

Covington, Ky.

# COMMUNICATIONS

## A LETTER OF PROTEST

In the *Journal of the American Medical Association,* May 6, 1933, appeared an editorial entitled "Disturbances of the Heart as Indication for Surgical Intervention in Hyperthyroidism," which appeared to the Editor of RADIOLOGY as showing such misinformation on the part of its writer that he felt constrained to voice a protest. The following letter has been sent to the Editor of the *Journal of the American Medical Association,* with the request that he publish it.

May 22, 1933

Dear Sir:

May I call to your attention certain inaccuracies which occur in your editorial on "Disturbances of the Heart as Indication for Surgical Intervention in Hyperthyroidism," appearing in the May 6, 1933, issue of the *Journal of the American Medical Association.*

The character of editorials appearing in that *Journal* has been of such high order that the countless physicians reading them are all agreed that they represent the latest and most accurate thought in the advancement of modern medicine. When we find deviation from such standards in arraigning a well known and accepted method of treatment we naturally look for an explanation in order that we may have a better understanding of the motive activating such a departure.

It would seem that our parent organization should be free from partisanship and deal alike with all of its members. It appears that this principle has not been adhered to in this editorial. There can be no denying the fact that certain physicians representing specialized branches of medicine become over-enthusiastic in regard to some method or methods of treating disease. This is true not only of radiologists but of other specialists as well. However, this cannot apply in the instance of the treatment of thyrotoxicosis by irradiation.

The editorial begins with: "The behavior of the heart in hyperthyroidism presents a number of interesting problems for the surgeons and internists." Why not also the radiologists, who have occasion to see thousands of such cases? Is it because the writer thinks that radiologists lack sufficient knowledge to enable them to appreciate the interesting problems mentioned, and for this reason are ignored? The treatment of goiter to-day is as much a radiologic problem as it is surgical.

The editorial further states that "It seems generally agreed that the most efficient method of treating thyrotoxicosis to-day is by subtotal removal of the thyroid gland." It would be interesting to know where such information was obtained, and in what manner. There is hardly a town of any size in this country in which toxic goiter is not being treated by irradiation and in a most satisfactory manner.

The editorial contains another inaccurate statement wherein it is said that "Attempts at control of these symptoms [speaking of toxic goiter] by roentgen irradiation or by iodine therapy are, as a rule, inefficient, while valuable time is wasted and pathologic changes in the cardiovascular system progress." Again I ask how this information was obtained. Is it the reaction of an internist or surgeon? Has an honest effort been made to ascertain the status of radiology in the treatment of this disease before censuring a method of which the writer apparently knows little? For his information I give actual statistics obtained in an impartial, unbiassed, and unprejudiced manner. When surgical statistics are obtained in a similar manner there will be a change of opinion from that expressed in the editorial in question.

In the March, 1932, issue of RADIOLOGY will be found a paper on the Radiological Aspect of Thyrotoxicosis which clearly

shows a true and impartial evaluation of radiation treatment of toxic goiter. The statistics presented were obtained from radiologists of varied experience in the treatment of this disease, some reporting on as few as five cases, others on hundreds, and one on 1,500. The percentage of satisfactory results was least in the instance of radiologists treating small numbers of cases and highest among those treating large numbers of cases, but to render a fair and unbiassed report the general average was taken. This showed a percentage of cures of 66.22; marked improvement in 21.07; recurrence in 8.45; failure in 12.4. I am quite sure that the percentage of cures compares favorably with that of surgery if a study be made of the surgical cures reported by general surgeons and not by a few expert goiter surgeons. In this study it was also shown that, of the 10,500 cases treated by radiation, nearly 1,000 had been operated upon previously.

Another misleading statement is made in your editorial. You mentioned that it is reported that the mortality rate following surgical operation for toxic goiter is less than 1 per cent. What good news would this be to the goiter patients who contemplate surgical intervention, if only it were true! No doubt, in a few—and a very few—surgical institutions of note such a low mortality rate is correct, but only a small percentage of goiter operations the country over are done in these institutions. After all, what counts is what general surgeons are doing, not just a few clinics, though they be large. General surgeons, most capable in other surgical fields, but such as lack specialized experience in goiter surgery, show a surgical mortality which is far higher than "less than 1 per cent." The medical profession and the public are getting tired of hearing of this "less than 1 per cent" mortality because they know better. Why not be frank with ourselves and state the true rate of mortality, as nearly as we can arrive at it?

In 1929, A. B. Cooke stated that there was a general increase in surgical mortality rates during recent years, and that thyroid surgery headed the list, with a mortality rate which had increased 250 per cent in the preceding two decades. He believed the reason for this increase to be that every local surgeon to-day operates on goiter cases, while several years ago operation was done by only a few experts. Before him, N. J. MacLean, writing in 1921, made a survey to ascertain the surgical mortality in exophthalmic goiter, sending questionnaires to 100 United States and Canadian hospitals. The replies indicated that a mortality rate of 8 per cent existed then. Some time later he sent questionnaires to 200 additional hospitals, and obtained about the same percentage, the mortality rate being then 7 per cent. There is nothing to indicate any sharp drop in the percentage since these surveys were made.

It is not my desire to undermine or to minimize the importance of surgery in the treatment of toxic goiter, but I do object to letting pass without comment an editorial distinctly and unjustly antagonistic to radiation. Also, I take exception to the fact that so little information was obtained before the *Journal* proceeded to publish an editorial against an accepted method, employed throughout the world in the treatment of toxic goiter.

Sincerely yours,
LEON J. MENVILLE, M.D.

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## AMERICAN CONGRESS OF RADIOLOGY

SEPTEMBER 25–30, 1933

Chicago during the World's Fair will welcome the largest radiological congress ever held in the United States when the four national radiological societies will meet there in joint convention. Other members of the medical profession are invited as well. The American Congress of Radiology is sched-

uled for September 25-30, inclusive, at the Palmer House. According to Dr. Henry K. Pancoast, of Philadelphia, President of the Congress, all physicians, physicists, biologists and others connected with the allied sciences will be made welcome at the Congress.

The four radiological societies sponsoring the Congress that have eliminated their regular annual meetings for 1933 in its favor are: The American College of Radiology, the American Radium Society, the American Roentgen Ray Society, and the Radiological Society of North America. The Chicago Roentgen Society will also participate.

Scores of visitors from Central and South American countries are expected to attend the Congress, and invitations have been sent to European colleagues. Over a hundred and fifty essayists will devote 55 full hours to the scientific program. The six-day program, however, places the scientific meetings to terminate at 2:00 P.M., leaving the afternoons free for visiting the Century of Progress World's Fair. Incidentally, the Fair itself will have remarkable worthwhile displays showing the development of the x-rays and radium in their medical applications.

Benjamin H. Orndoff, M.D., of Chicago, Chairman of the Executive Council of the Congress, invites members of the medical profession to inquire further of him by writing to 2561 N. Clark Street, Chicago, concerning membership in the Congress, railroad and hotel rates, etc. He points out that the Palmer House is reserving 1,400 rooms for the period of the Congress and guarantees that rates will not be increased or other prices advanced during the session. The Palmer House was selected for the Congress because it is so well arranged for such an event, and the scientific sessions, as well as scientific and commercial exhibits, will all be on one floor.

Numerous committees are hard at work planning the Congress. Among these are the History and Education Committee, headed by Byron H. Jackson, M.D., of Scranton, Pa., President of the Radiological Society of North America. This committee will publish a special volume, known as "Science of Radiology," for the members of the Congress, and will sponsor an unusual exhibit of old medical texts which will trace the history of radiology from the early chemistry of the Middle Ages. Other Committees include those on Publicity, James T. Case, M.D., of Northwestern University, Chicago, Chairman; Committee on Local Arrangements, M. J. Hubeny, M.D., of Chicago, Chairman; Scientific Exhibits, B. R. Kirklin, M.D., of the Mayo Clinic, Rochester, Minn., Chairman; Scientific Program, George E. Pfahler, M.D., of Philadelphia, Chairman; Publications, Leon J. Menville, M.D., of New Orleans, and Lawrence Reynolds, M.D., of Detroit, Co-chairmen; Committee on Photography, A. U. Desjardins, M.D., of the Mayo Clinic, Rochester, Minn., Chairman; Commercial Exhibits, John T. Murphy, M.D., of Toledo, Ohio, Chairman; Finance, E. L. Jenkinson, M.D., of Chicago, Chairman; Travel and Transportation, Henry Schmitz, M.D., of Chicago, Chairman; Membership, Albert Soiland, M.D., of Los Angeles, Chairman.

The President of the Congress is Henry K. Pancoast, M.D., of Philadelphia. The Vice-presidents are: Albert Soiland, M.D., of Los Angeles, as President of the American College of Radiology; Burton J. Lee, M.D., of New York, as President of the American Radium Society; John T. Murphy, M.D., of Toledo, Ohio, as president of the American Roentgen Ray Society, and Byron H. Jackson, M.D., of Scranton, Pa., as President of the Radiological Society of North America. The other officers are: Chairman of the Executive Council, B. H. Orndoff, M.D., of Chicago; Secretary of the Council, E. L. Jenkinson, M.D., of Northwestern University, Chicago; Treasurer of the Council, Henry Schmitz, M.D., of Loyola University, Chi-

cago. The Executive Council, aside from the names just given, includes the chairmen of the various committees.

JAMES T. CASE, M.D., *Chairman*
*Publicity Committee.*

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## DR. ALBAN KÖHLER HONORED

During the meeting of the German Roentgen Society which took place in Bremen, April 22-24, the Rieder Gold Medal was awarded to Dr. Alban Köhler, of Wiesbaden, for outstanding work in roentgenology. This honor has been awarded to the late Guido Holzknecht, of Vienna, and to Gösta Forssell, of Stockholm.

The Radiological Society of North America offers its congratulations to Dr. Köhler, who is teacher and friend to many of our members.

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## ANNOUNCEMENT

At the request of James T. Case, M.D., the following notice is published.

The Reunion of French Language Physicians practising radiology and electrology (Medecins Electroradiologistes de Langue Française), under the auspices of the Société Française d'Electroradiologie et de Radiologie medicales, of the Société de Radiologie medicale française and of the Société Belge de Radiologie, to which are invited French-speaking physicians of whatever nationality, will be held in Paris, Oct. 12, 1933, at the Faculty of Medicine at the same time as the Congress of Surgery.

The following questions will be the order of the day:

1. The radiological examination of the mucosa of the large intestine. Reporters: Dr. Ledoux-Lebard, chief of service of medical electroradiology to the Hospitals of Paris, and Dr. Gilbert, medical radiologist of the Cantonnal Hospital of Geneva.

2. The short waves. Reporter: Professor Rechou, of Bordeaux, assisted by Dr. Auclair, Dr. Dausset, and Dr. Droust.

The officers of the Congress are as follows: Dr. Belot, *President;* Dr. Delherm, Dr. Rechou, and Dr. Dubois-Trepagne, *Vice-presidents;* Dr. Dariaux and Dr. Portret, *Secretaries;* Dr. Morel-Kahn, *Treasurer.*

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## BOOK REVIEWS

THE PELVIS IN OBSTETRICS. A Practical Manual of Pelvimetry and Cephalometry, Including Chapters on Roentgenological Measurement. JULIUS JARCHO, M.D., F.A.C.S., Consulting Roentgenologist, Hastings Hillside Hospital; Attending Obstetrician and Gynecologist, Sydenham Hospital. A volume of 365 pages, 140 illustrations, and 51 tables. Published by Paul B. Hoeber, Inc., New York, 1933. Price $6.00.

This volume, a good example of the publisher's art, is printed on good quality paper using large, easily legible type; the illustrations are profuse and well-made and convey an excellent first impression. The value of this book, however, lies not in any original material, for no pretense of novelty is made, but in a compilation of rather widespread data, so that its significance is more as a basis for future analysis and comparison of pelvic measurements than in its immediate practical application.

Virtually every possible manual and caliper measurement that has ever been made is well described, portrayed, and evaluated. The tables of racial variation in pelvic size should prove of special interest to practitioners who find

themselves in contact with a varied racial element among their patients.

The chapter on x-ray pelvimetry is clearly written. Perhaps too much is made of the various "different" methods which in the end resolve themselves into but two, the stereoscopic triangulation and the target-film over object-film proportion types. However, these are well described and are undoubtedly of considerable value.

The chapter on cephalometry is likewise well done. Whether more mention of the difficulties of determining the exact sites of the fetal head *in utero*, and of maintaining them while exposures are being made, should not have been made, is open to question.

The bibliography is excellent and should make it practically unnecessary to go back beyond this time to cover the literature in this field. It shows a careful search of past endeavors. The book, as a whole, should prove of widespread interest, although to the well-posted radiologist it offers little save a compilation of data; that alone, however, should make it worthy of a place in his library.

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EINFÖHRUNG IN DIE RÖNTGENOLOGIE. A Textbook for Physicians and Students. G. F. HAENISCH, Prof. Dr. Med., Leitender Oberarzt am Allgem. Krankenhaus Barmbeck, Hamburg, and H. HOLTHUSEN, Prof. Dr. Med., Leitender Oberarzt am Allgem. Krankenhaus St. Georg, Hamburg. With a physical-technical introduction by A. LIECHTI, Priv.-Doz. Dr. Med. Chefarzt am Inselspital, Bern. A volume of 359 pages and 299 illustrations and drawings. Published by Georg Thieme, Leipzig, 1933. Price, 25 marks.

As indicated in the title, this is an introduction to roentgenology, so the material has been contracted down to the point where it can be assimilated readily by students or physicians without previous training in roentgenology.

As is usual in the publications of this house, the printing and illustrations are beautifully done. The diagrams are numerous and clarifying. While the section on physics and technic, comprising about 44 pages, is complete, it seems more elaborated than necessary for a student's textbook. It may be criticized because so little attention is paid to roentgenographic technic, an important feature of the student's training.

The section on diagnosis, written by Dr. Haenisch, is notable for its clarity of language, which makes it easy reading for the non-German student. The general statement of the principles of roentgen diagnosis is unusually good and is well worth study even by specialists in the field. Furthermore, the detailed analysis of roentgenograms of several different portions of the body represents a fine achievement in demonstrating the fundamentals of roentgen diagnosis. The general *critique* of the value and limitations of the roentgen method, while rather conservative, is very well written.

The specific details of regional diagnosis are, however, briefly done. The whole section comprises only about 150 pages, so there is little room for detail. This is perhaps justifiable in this type of text, but there would seem to be a marked disproportion in an allocation of space which gives the therapeutic and physics sections of a textbook for general practitioners much more space than that assigned to the diagnostic section. The latter will inevitably be much more used. Notable omissions, due undoubtedly to the need for brevity, are encountered.

The section on roentgen therapy was written by Prof. Holthusen. On the whole, the treatment of the subject is excellent, the broad discussions of the effects of radiation on cells being particularly commendable. In the detailed discussion of the treatment of specific diseases, the book suffers from a tendency to include too many diseases in which the effects of radiation are most questionable. American readers may be particularly surprised to find pernicious anemia, gonorrhea, hemophilia, and abscesses of teeth, to mention only a few, discussed at some length as proper cases for roentgen therapy. Nevertheless, this section is well worth the perusal of the specialist in radiology, as well as the student.

DIE CURIE-RÖNTGENTHERAPIE BÖSARTIGER FRAUENLEIDEN (Curie-roentgentherapy of Malignant Disease in Women). By DR. STEFAN SIMON, Leiter der Strahlenabteilung der 1. Universitäts-Frauenklinik in Wien. Radiologische Praktika, XX. A volume of 122 pages and 78 illustrations. Published by Georg Thieme, Leipzig, Germany, 1933. Price, 13.20 marks.

In the introduction the author emphasizes the fact that although radiation therapy has many remarkable results to its credit, it must still be considered in its infancy. The proper application of radiant energy requires many years of specialized study and training in order that one may avoid the dangers connected with its use.

The book offers a precise and comprehensive outline of the present status of x-ray and radium therapy in the treatment of malignant tumors located in the female generative organs. In a general part the essentials of a proper preparation of the patient for the treatment are related, followed by a description of the technic of administering radium and x-rays. The biologic effect of radiation on normal and pathologic tissue is also dealt with briefly.

In the special part we find the various tumors discussed, arranged according to their location: cancer of the vulva, of the vagina, of the cervix uteri, of the corpus uteri. The carcinomatous blastoma in the ovary and the sarcoma of the generative organs are also mentioned. For each group the following points are discussed: clinical experience, structure of tumor, subdivisions, indications and contra-indications for radiation; the radical, prophylactic, and palliative treatment; treatment methods used as adjuncts, the after-care, prognosis, and statistical results.

Numerous well-chosen illustrations accompany the text, a good percentage of these being devoted to diagrams of radium applicators *in situ*. The radiologist who has a reading knowledge of German will be well rewarded for the time spent with the study of this monograph.

LES ABCÈS DU POUMON (Pulmonary Abscess). By M. LÉON KINDBERG, Médecin des Hôpitaux de Paris, and ROBERT MONOD, Chirurgien des Hôpitaux de Paris, with the collaboration of A. SOULAS, Assistant d'O. R. L. à l'Hôpital Laënnec. A volume of 322 pages and 119 illustrations. Published by Masson et Cie., Paris, 1932. Price, 55 francs.

An internist and a surgeon, assisted by an otolaryngologist, have joined forces to write a comprehensive clinical study of the pulmonary abscess. The material is grouped under the following headings: general introduction, pathologic anatomy, etiology, clinical features, complications, diagnosis, various types of treatments (medical, bronchoscopic, surgical). In a concluding chapter the experience of the authors is critically analyzed, and definite therapeutic indications, based on their observations, are given for the various types of patients and pathologic processes. The text is profusely illustrated by more than a hundred roentgenograms and an extensive bibliography will be found at the end of the book. This monograph should appeal to the radiologist as well as to his confrères in the medical profession.

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ROENTGENSTEREOSCOPY IN DENTISTRY. By Privatdozent DR. J. v. RECKOW, Marburg. Vol. LXXXIII of "Deutsche Zahnheilkunde," 1933, with 80 pages and 21 illustrations. Published by Georg Thieme, Leipzig, Germany. Price, 6 marks.

The author reviews at great length the various stereoscopic methods, particularly regarding their application on dental problems. He then reports his own studies leading to certain conclusions as to the scope of roentgenstereoscopy in dentistry. If the distance between skull and film is 2 meters (teleostereoradiography), the whole skull can be taken on a relatively small film. Intra-oral stereoscopic films are indicated if two films, taken in different planes, are not sufficient to enable one to arrive at a diagnosis.

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E. T. Leddy, M.D.
Davis H. Pardoll, M.D.
E. A. Pohle, M.D., Ph.D.

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## BLOOD CHANGES

Changes in the Blood Picture after Roentgen Deep Therapy and Their Prognostic Value. Hans Bosch. Strahlentherapie, 1932, XLV, 503-524.

The author states that four factors usually produce changes in the blood picture in carcinoma patients following roentgentherapy: (1) the irradiation itself; (2) the indirect effect on the bone marrow; (3) the toxins produced by tumor necrosis; (4) the bacterial infection of the tumor.

The prognosis is, as a rule, favorable if there is only a slight drop of hemoglobin and erythrocytes, a decrease of the leukocytes immediately after the exposure which returns to normal within from eight to twelve weeks, a small drop in lymphocytes, a slight increase in polynuclear cells and eosinophils, and a drop of the monocytes and mast-cells. The opposite reaction of the blood must be considered as an unfavorable prognostic sign. The author emphasizes that one single factor should not be regarded as significant.

Ernst A. Pohle, M.D., Ph.D.

## CONTRAST MEDIA

Radiography of the Placenta and its Possible Clinical Applications. Domenico Vajano. Archivio di Radiologia, Sept.-Dec., 1932, p. 773-788.

The author carried out radiologic and histologic experiments on rabbits and guinea pigs and showed that it is possible to visualize the placenta by a single non-toxic intravenous or intracardiac dose of colloidal thorium (thorotrast) which is harmless to the fetus and to the mother. He, therefore, feels that the method may be worthy of a clinical trial.

E. T. Leddy, M.D.

## THE DIAPHRAGM

Examination of the Action of the Diaphragm in Hiccup by Means of Phrenography. Giovanni Paltrinieri. Rivista di radiologia e fisica medica, December, 1932, IV, 645-768.

The author studied two cases of hiccup, one of so-called paradoxical hiccup, by Palmieri's technic of phrenography (a simplified method of cinematography for the study of movement of the diaphragm, described in 1922). The study of his cases, illustrated by 15 figures in the paper, considers some of the findings which are of importance in the examination of the diaphragmatic function in normal and pathologic lesions.

E. T. Leddy, M.D.

## EXPERIMENTAL STUDIES

The Tissue Cultures in Plasma of Animals Exposed to Roentgen Rays. A. Calò. Strahlentherapie, 1932, XLV, 487-502.

Cultures of embryonal heart and spleen were grown in the plasma of chickens which had received

total body irradiation with roentgen rays (180 K.V., 3 ma., 31 cm. F.S.D., 2.0 Al, 2100 r). They showed an increased growth as compared with cultures growing in the plasma of normal animals. Malignant tumor cells treated in the same manner showed a definite inhibition of growth. Cultures of embryonal tissues and of tumors growing in the plasma of Rous sarcoma chickens exposed locally over the tumor showed definite inhibition of growth. This was most pronounced in cultures of Rous sarcoma. The effect of the plasma on the cultures had its optimum if the plasma was prepared 24 hours after the irradiation. If the plasma is kept in a test tube for a longer time, the effect disappears.

ERNST A. POHLE, M.D., Ph.D.

## GALL BLADDER (NORMAL AND PATHOLOGIC)

Congenital Urinary Obstructions in Male Children. W. A. Frontz. Jour. Urol., April, 1932, XXVII, 489-501.

The author reports several cases of unusual anomalies occurring in male children presenting obstructive symptoms. He has attempted to classify these lesions in various groups, depending upon their anatomic configuration.

A number of pathologic specimens demonstrating this form of anomaly are reproduced in the article along with the cystograms.

DAVIS H. PARDOLL, M.D.

A Contribution to the Radiologic Study of Pericholecystic Deformities. Pietro Perona. Archivio di Radiologia, Sept.-Dec., 1932, p. 719-765.

Prof. Perona, of Padova, first reviews some of his previous work on the morphology of the gall bladder and on perivisceritis secondary to appendicitis and traces schematically the various aspects of cholecystic adhesions as shown by operation, discussing their origin and development. He shows that dislocations and deformities of the gall bladder always have some special pathologic background and that in each examination a checking of the function of the gall bladder is of great assistance. Strawberry gall bladder may sometimes present a confusing radiologic picture. In pericholecystitis there may be found decreased density, blurred outlines, and delayed emptying, due to the simple fact that the normal function of the gall bladder is impeded by external factors.

E. T. LEDDY, M.D.

## GASTRO-INTESTINAL TRACT (DIAGNOSIS)

Evaluation of Compression Technic in the Roentgen Demonstration of Duodenal Lesions. Milton J. Geyman. Am. Jour. Roentgenol. and Rad. Ther., August, 1932, XXVIII, 211-222.

While some workers claim ability to demonstrate the niche of duodenal ulcer in 90 per cent of cases, the expected percentage will probably be somewhere between 45 and 75. After a considerable experience in the routine application of the compression method of study to all gastro-intestinal cases, a 64 per cent demonstration of the ulcer niche in the entire series diagnosed as duodenal ulcer was obtained by the writer. A Chaoul compressor applied after the administration of about one ounce of thin watery suspension of barium is the method recommended, a fairly large series of films at various angles being necessary for satisfactory study. The compression method with films is definitely more accurate than compression fluoroscopy only. In certain ulcers with the cap sharply contracted the compression method may fail to demonstrate the niche as surely as when the cap only is in the filled state; in the latter case the method may occasionally fail to demonstrate an ulcer deformity in the presence of ulcer. It is no uncommon thing to demonstrate two or even more ulcer craters by the compression method, this affording, of course, a more exact diagnosis that would be possible by other methods. In the course of treatment it is at times possible to demonstrate the decrease in size or disappearance of the crater, while the filled cap may show an essentially unchanged defect. In a period of a year and a half there was only one case in which the least suspicion existed that the pressure exerted by the compressor may have hastened a perforation.

J. E. HABBE, M.D.

A Contribution to the Knowledge of the Variations in the Length of the Colon in the Adult. Dino Mantovani. Rivista di radiologia e fisica medica, December, 1932, IV, 685-726.

Mantovani describes an anomaly occurring in a redundant colon in the adult which may present obscure and confusing symptoms resembling those of many abdominal lesions, but which are, in fact, only reflex symptoms originating in this anomaly. He regards the anomaly of idiopathic origin. In his case there was also a bicornate uterus. He also presents a detailed study of 16 interesting cases in which the colon was studied.

E. T. LEDDY, M.D.

A Case of Tuberculosis of the Small Intestine. Ettore Colombo. Archivio di Radiologia, Sept.-Dec., 1932, p. 766-772.

The author reports a case of tuberculosis of the upper loops of the small intestine, presenting the same findings as described in detail by Freud, and characteristic of sarcoma. The diagnosis was confirmed by operation but without a biopsy.

E. T. LEDDY, M.D.

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